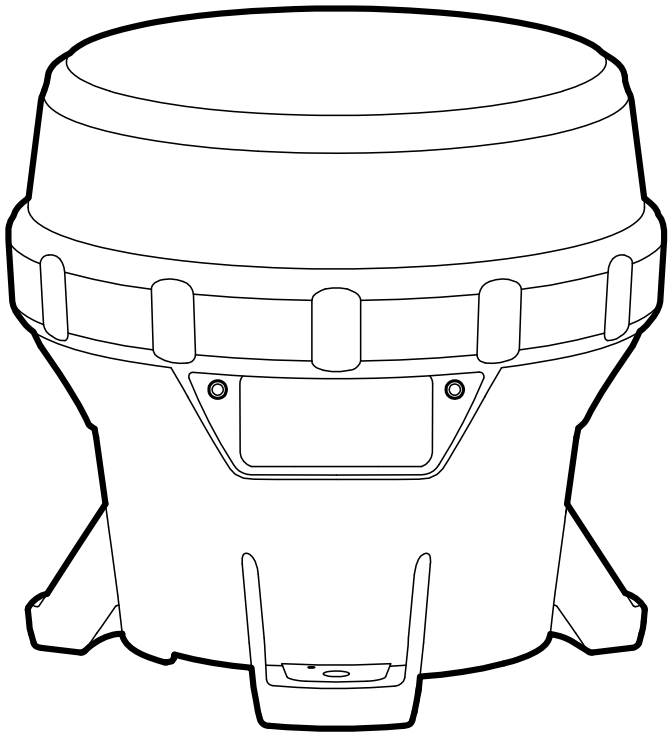
carmanah®

M650 GPS V2

USER MANUAL



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Warnings and Precautions

The following symbols indicate important safety warnings and precautions throughout this manual. They are defined as follows:

WARNING indicates that serious bodily harm or death may result from failure to adhere to the precautions.

CAUTION indicates that damage to equipment may result if the instructions are not followed.

NOTE suggests optimal conditions under which the equipment will operate effectively and safely, or provides additional information to the reader.

Regulatory Information

This Class [B] digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe [B] est conforme à la norme NMB-003 du Canada.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. Installation work must be done by a qualified person(s) in accordance with all applicable local codes and standards.

Equipment shall be positioned outside the 5m vicinity of a compass as per ISO 694.

Safety and Usage Precautions

The M650 GPS's Battery Pack contains lead, lead compounds, and other compounds known to the State of California to cause cancer and reproductive harm. Please handle with care and wash your hands thoroughly after handling the Battery Pack.

Charge your M650 GPS's Battery Pack periodically. Permanent damage and reduced capacity will result if the Battery Pack is not correctly maintained. Refer to page 19 for details on how to maintain your Battery Pack.

M650 GPSs that have been stored will usually require a top-up charge before they are put into service. The most accurate Battery Pack Health status reading is obtained when the M650 GPS has been in a dark location and in Off mode for at least 24 hours.

Warranty Disclaimer

This manual will familiarize you with the features and operation standards of Carmanah's Model M650 GPS lantern. Failure to comply with the use, storage, maintenance, installation or placement instructions detailed in this manual could void the applicable user warranty.

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Introduction

M650 GPS Applications

The **M650 GPS Solar Marine Lantern** has the following marking applications:

- Aids to navigation
- Marina and dock Lighting
- Port lighting
- Oil and offshore platforms
- Channel boundaries
- River mouths
- Marina entrances
- Extended structures such as aquaculture floats or breakwaters

Like Carmanah's larger GPS-equipped solar marine lanterns, the M650 GPS uses the precise timing signal of GPS satellites to synchronize its flash pattern with other M650 GPS lanterns. The M650 GPS is also designed to harmonize with Carmanah's other GPS-equipped lanterns, which means a mix of different models all flash perfectly together. No special programming is required - the GPS synchronization function works automatically as soon as the lantern is deployed.

Synchronized flashing is very effective in overcoming background shore lighting and clearly marking the boundaries of water systems or the physical dimensions of floating structures.

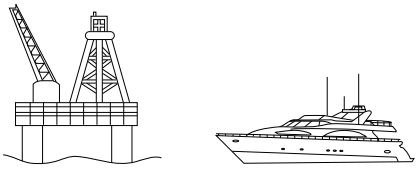
With synchronized flashing, the M650 GPS also satisfies the US Coast Guard's PATON Part 67 regulations that require unison flashing where multiple lanterns mark an obstruction.ut (green).

The M650 GPS does not use latitude and longitude information from the GPS satellite network. Latitude and Longitude must be set by the distributor using the 650 Device Manager software.

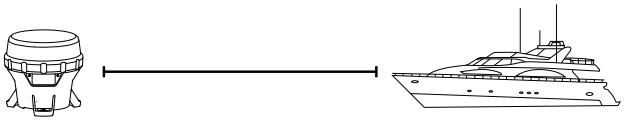
Common Features and Functionality

The M650 GPS:

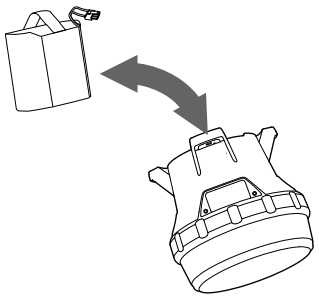
- Is a self-contained, high-performance, low-maintenance and easy-to-install solar-powered light source.
- Is programmed for geographical location to optimize output and prevent a user from potentially damaging the product.
- Is suitable for a range of marine and obstruction applications.



- Is visible from up to approximately 4 nautical miles (7 kilometres), depending on the solar energy available at the installation location and the selected Flash Code.



- Is durable and reliable with double o-ring sealing.
- Offers dusk-to-dawn operation with programmable transition levels.
- Features a replaceable Battery Pack.



- Has a tool-less removable Bottom Cover for accessing the On-Board User Interface (OBUI).
- Has an efficient optical design.
- Has over 250 user-programmable flash patterns.

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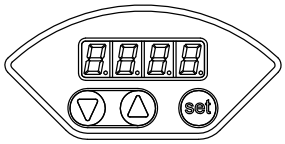
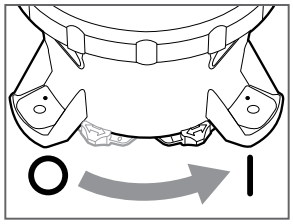
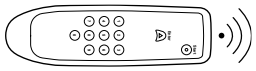
- Has four different user interfaces:
  - On Board User Interface (OBUI)



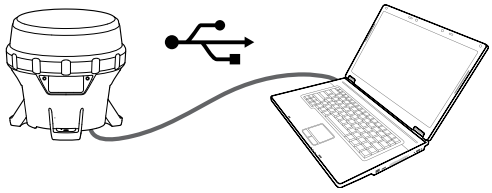
  - (Optional) On/Off Switch



  - (Optional) Infrared Programmer



  - 650 Device Manager software, via USB cable



- Has multiple layers of programmable password protection.
- Is available in red, green, yellow, white and blue LED output colours.
- Is designed in accordance with the European Union's guidelines for the Restriction of Hazardous Substances in electronic equipment (RoHS).

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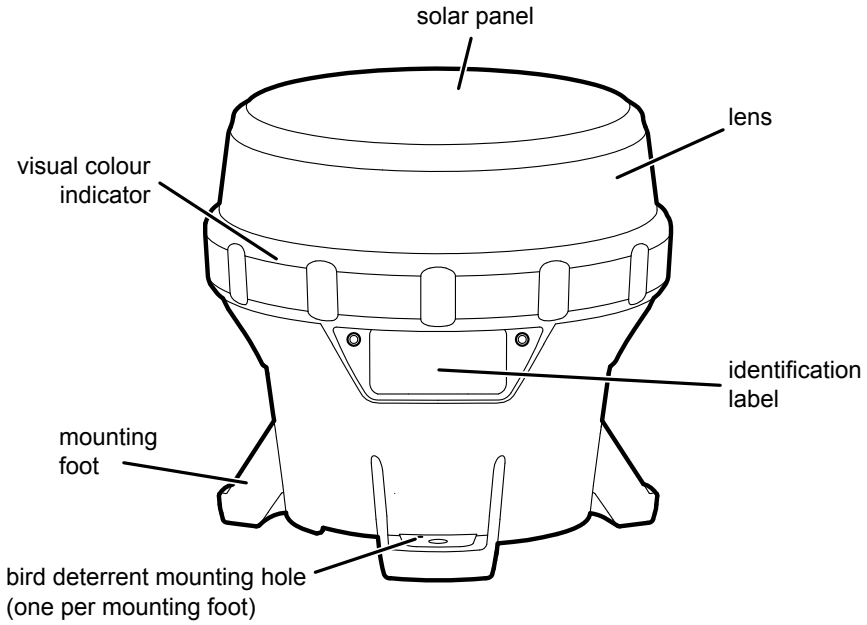
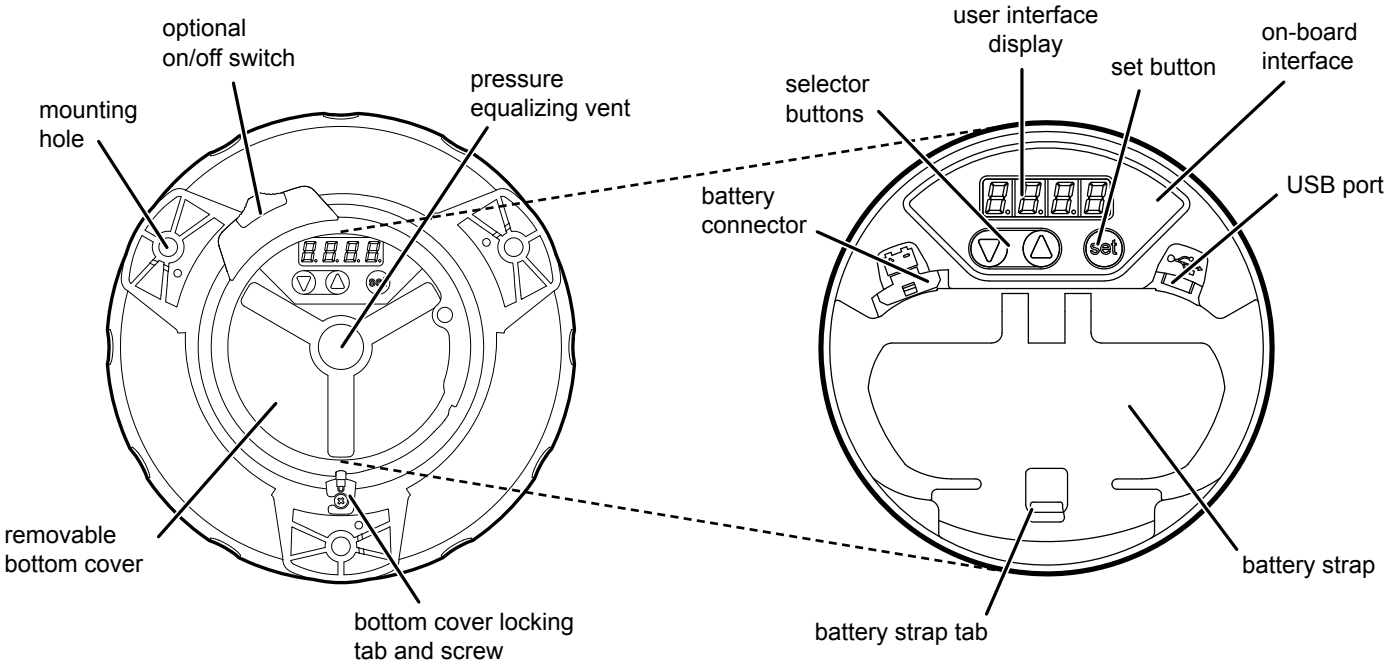
M650 GPS Parts Description



SIDE VIEW



BOTTOM VIEW

INTERNAL VIEW
(BOTTOM COVER REMOVED)

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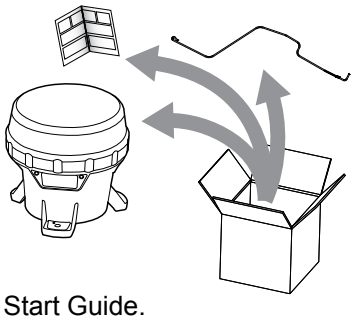
Getting Started

What's in the Box?

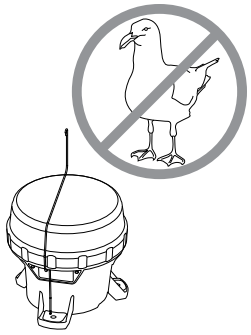


The M650 GPS ships in a small cardboard box. Each box contains:

- One M650 GPS lantern.
- One Bird Deterrent.
- One illustrated Quick Start Guide.

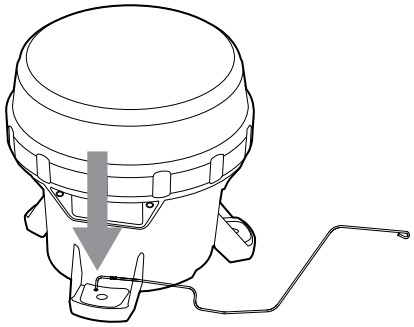
NOTE The M650 GPS User Manual (this document) is separate from the M650 GPS and is available for download in PDF format from carmanah.com.

Installing the Bird Deterrent

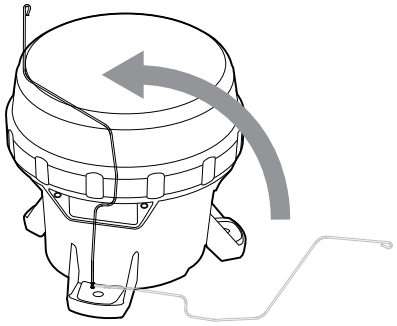


Included with each M650 GPS is one Bird Deterrent. If bird fouling of the M650 GPS is a concern in your installation environment, install the Bird Deterrent as follows:

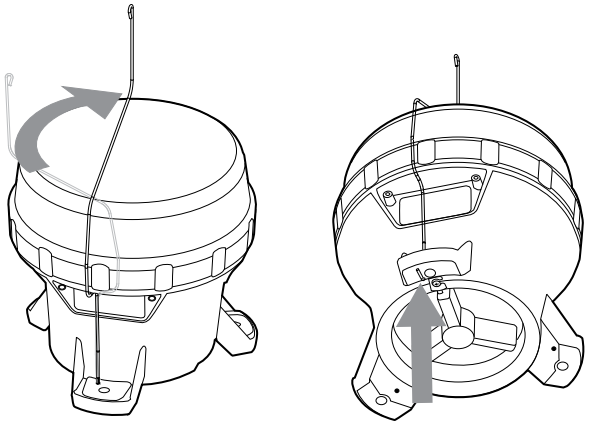
1. Insert the short L-shaped end through the small hole in the top of one of the M650 GPS mounting feet.



2. Rotate the wire upwards 90 degrees until it is in the upright position.



3. Twist the Bird Deterrent clockwise until the L-shaped end snaps into the groove on the bottom of the mounting foot. The Bird Deterrent extends over the top of the M650 GPS to prevent birds from landing on the M650 GPS.



NOTE The M650 GPS can be fitted with up to three bird deterrents.

On/Off Switch (Optional)

The M650 GPS is available with an optional On/Off Switch which is located on the M650 GPS's Bottom Cover. The On/Off switch allows you to:

- Shut off the LEDs (while allowing the M650 GPS to continue charging).
- Activate Standard On (Dusk-to-Dawn) or Fog Mode.
- Initiate a Status Report (see page 12) without having to remove the Bottom Cover.

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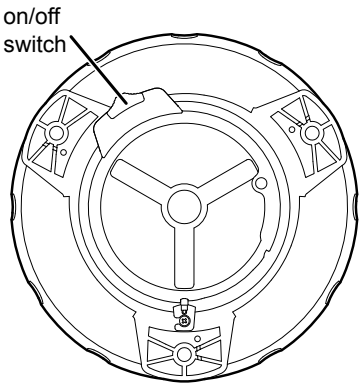
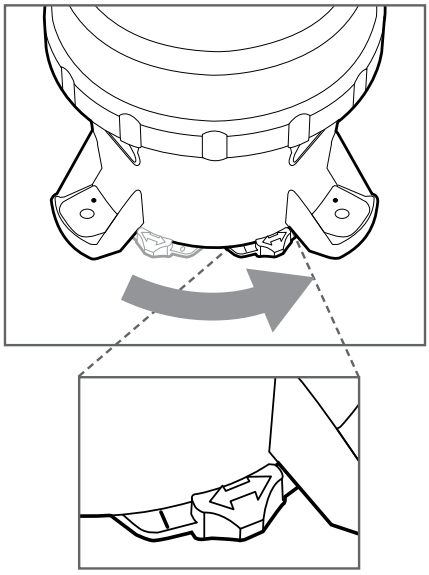
When switched off, the M650 GPS remembers its Flash Code, intensity, and other settings.

NOTE With the switch in the Off position, the M650 GPS's LED will not turn on, and it will not respond to commands from the IR Remote. The M650 GPS will, however, charge its Battery Pack when exposed to sunlight, regardless of the position of its switch.

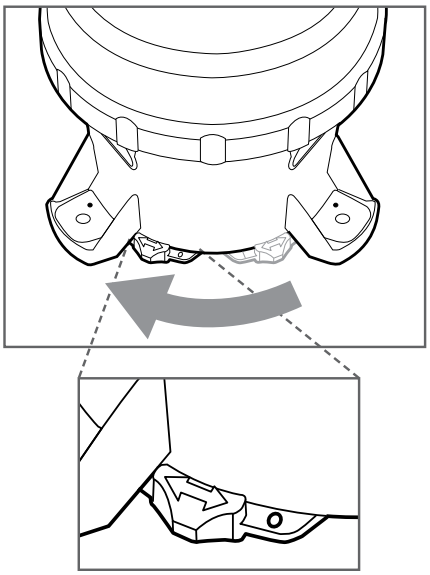


The switch has two positions, **On** (**I**) and **Off** (**O**).

1. To put the switch in the **On** position, slide the switch to the right until it snaps into position. In the **On** position, a "**I**" symbol is visible on the switch.



2. To put the switch in the **Off** position, slide the switch to the left until it snaps into position. In the **Off** position, a "**O**" symbol is visible on the switch.

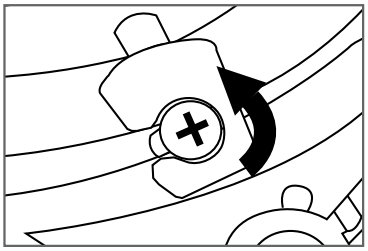


NOTE Removing the bottom cover is equivalent to placing the switch in the **On** position.

Bottom Cover Lock

You can lock or unlock the M650 GPS Bottom Cover by tightening or loosening the locking screw from the tab on the Bottom Cover. Tightening the screw renders the Bottom Cover tamper-proof when it is installed against a flat surface using security fasteners.

NOTE To unlock the Bottom Cover, loosen the screw; it does not need to be fully removed.



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Operation

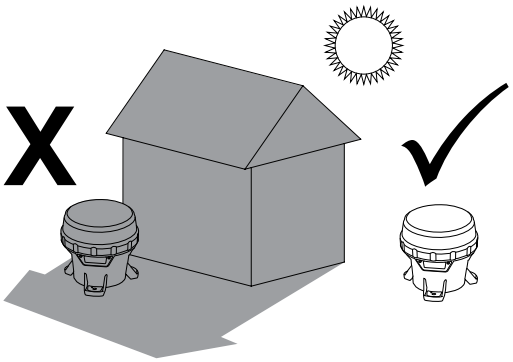
Choosing an Installation Location

NOTE

Full solar exposure is critical to the M650 GPS's long-term performance. Ensure that the installation location has year-round, unrestricted sun exposure throughout the day.

Choose a Sunny Location

During the winter, the sun is lower on the horizon. Because the angle of the sun changes with the seasons, you must be aware that obstructions such as trees, buildings, and mountains that do not shade the M650 GPS during the summer may shade it during the winter. Choose your installation location very carefully to prevent this situation, because shade dramatically reduces the ability of the M650 GPS to charge its Battery Pack.

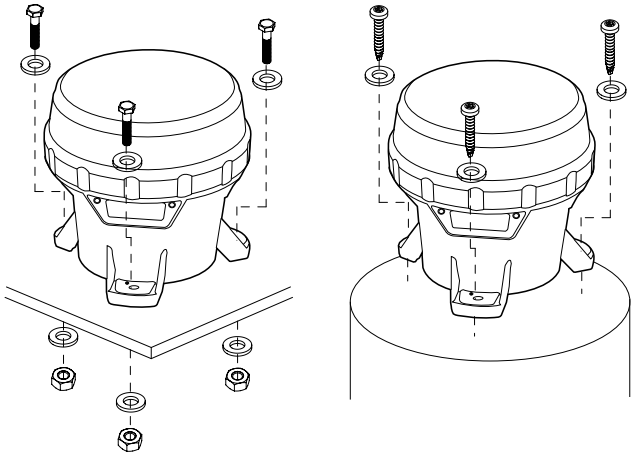


Cooler is Better

The M650 GPS Battery Pack lasts longest if you can minimize its exposure to high temperatures. Choose a location that is away from hot, dark coloured surfaces, like asphalt or black steel plate. Carmanah offers mounting kits that can help reduce the temperature of your Battery Packs, allowing longer replacement intervals.

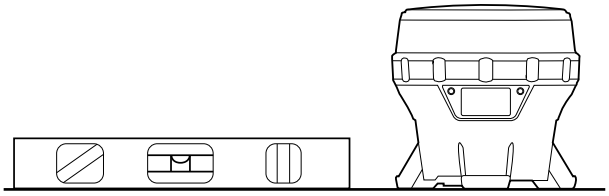
Installing the M650 GPS

The M650 GPS has three mounting feet with holes for ¼" (M6) fasteners (fasteners are not included, and can be ordered as an optional kit). The three holes are 120° apart, and have a bolt circle diameter of 5.9" (150mm). You can use these holes to mount the M650 GPS to a variety of surfaces.



CAUTION

Ensure the mounting surface is flat and level. The surfaces in contact with the three mounting feet must be flat to within 0.120" (3 mm) of one another or the M650 GPS chassis could twist when tightened down.



Torque the mounting fasteners to a minimum of 4 ft-lb (5.4 N-m).

NOTE

Carmanah has various M650 GPS mounting kits available. Please visit carmanah.com or contact a Carmanah distributor or sales representative for more information on purchasing one of these kits.

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Configuring the M650 GPS

Methods

You can program the M650 GPS using:

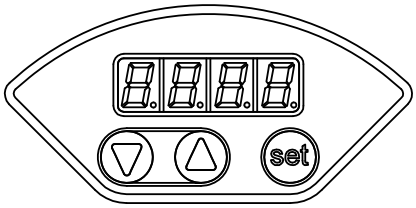
- The **On-Board User Interface (OBUI).** Refer to the following section for detailed information about using the OBUI. Note that you must remove the Bottom Cover to access the OBUI buttons.
- The **650 Device Manager software.** Detailed information about using the 650 Device Manager software is located in Appendix A. Note that you must remove the Bottom Cover to access the USB port and use the 650 Device Manager software.

NOTE Typically, a Distributor uses the 650 Device Manager software to configure your M650 GPS. Using the 650 Device Manager software, the Distributor can program a configuration, set the installation location environmental parameters, change passcodes, update firmware, etc.

You can perform some basic configuration using:

- The optional **On/Off Switch**. Detailed information about using the On/Off Switch is located on pages 8 and 18 of this document. You do not have to remove the Bottom Cover to use the On/Off Switch.
- The optional **Infrared Remote Programmer (IR Remote).** Detailed information about using the IR Remote is located in Appendix B. You do not have to remove the Bottom Cover to use the IR Remote.

On-Board User Interface

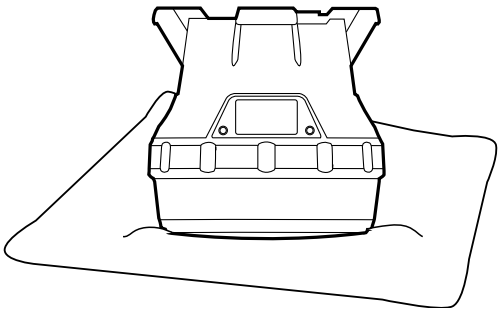


You can use the On-Board User Interface (OBUI) to configure many of the lantern's parameters and features. To use the OBUI to configure the M650 GPS, first remove the Bottom Cover.

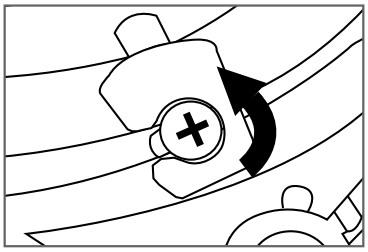
Removing the Bottom Cover

Removal of the Bottom Cover is required to configure the M650 GPS using the OBUI.

1. Turn the M650 GPS upside down and place it on a soft cloth (to avoid scratching the housing).



2. Locate and turn the locking screw counter-clockwise to allow the locking tab to clear the screw head (you do not have to remove the locking screw).



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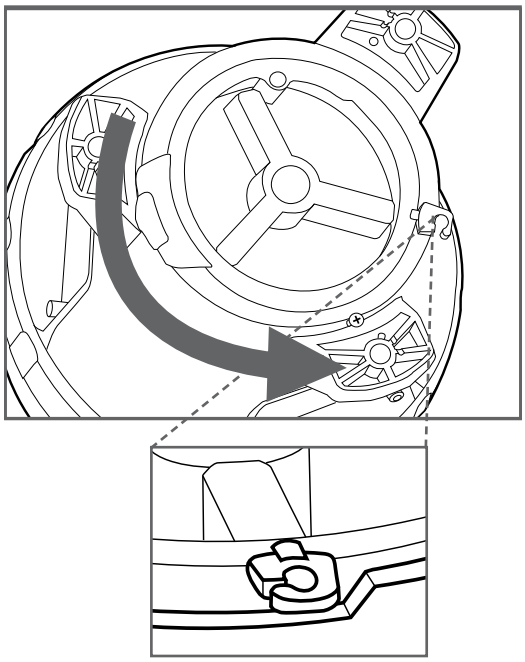
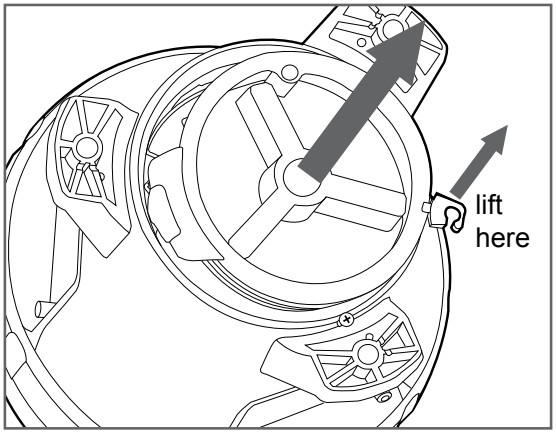
3. Secure the M650 GPS so it won't move, and then firmly twist the Bottom Cover counter-clockwise until it stops.



4. Lift the cover out by pushing up on the protruding locking tab. You now have access to the OBUI buttons or the USB connector port (for using the 650 Device Manager software). This is also the first step when replacing the Battery Pack.



Status Report

After you remove the Bottom Cover, you can use the OBUI to query the status of various M650 GPS parameters (without editing them) by pressing and briefly holding one of the three buttons under the display.

The display then reports the following parameters:

1. batt: Battery Pack health status. (pg. 21)
2. FLSH: programmed Flash code. (pg. 14)
3 Int: programmed effective intensity in candela. (pg. 14)
4. ALC: Automatic Light Control (ALC) status - **on** or **off** (pg. 15)
5. Date: current date (pg. 15)
6. Info: programmed firmware version (pg. 33)
7. Lat: programmed latitude setting (pg. 47)
8. Long: programmed longitude setting (pg. 47)
9. GPS: GPS receiver status (pg. 16)
10.vBat: Actual battery voltage in millivolts. Display looks like "ubat". (pg. 16)

When you are logged in to the M650 GPS, you will see two additional parameters:

11. rSet: Reset M650 GPS configuration (pg. 16)
10. test: Manually invoke an internal BIST (Built-In Self Test) to verify correct operation of components and sub-systems (pg. 16)

OBUI Editable Parameters:

FLSH (Flash Code), Int (Effective Intensity)
ALC (Automatic Light Control)
Date (Calendar year, month and day)

Non-Editable Parameters:

Batt (Battery Status)
Info (Firmware version)
Lat (Programmed Latitude)
Long (Programmed Longitude)
GPS (GPS receiver status)
vbat (Battery voltage)

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After the parameters have finished scrolling, **Hold Set to Edit** will appear on the display. The display will then repeat the status report, finishing with **Hold Set to Edit**. The display will then turn off.

NOTE

By pressing the up/down arrow buttons, you can scroll through the parameters at your own pace. The display will turn off after 60 seconds of button inactivity.

Editing Parameters

To edit any of the parameters, press and hold the set button for approximately one second. After entering the passcode (see the next section), you will be able to edit parameters as described in the sections that follow.

NOTE

For models equipped with the optional external switch, moving the switch from the **Off** to the **On** position will initiate a status report. A status report will also result if the switch is in the **Off** position, and the Bottom Cover is removed.

Entering the Passcode

Before you can edit any of the M650 GPS's parameters, you must enter a Passcode. The default Passcode is **753**.

To enter the Passcode:

1. Press and hold the **set** button for approximately one second. The words **Pass Code** briefly display on the OBUI, followed by three zeroes with the left zero flashing. The display is prompting you to enter the Passcode beginning with the first digit.

2. Enter **753** on the display. Use the arrow buttons to change the number, and press the **set** button briefly to advance to the next digit.

3. When **753** displays, press and hold the **set** button again for approximately one second. **753** flashes quickly to indicate that you have successfully entered the Passcode and are now logged in to the OBUI. Use the arrow buttons to scroll through the editable fields.

NOTE

You can change the Passcode using the 650 Device Manager software (Appendix A). This is recommended to improve M650 GPS security.

NOTE

If you do not edit any of the settings, the OBUI exits the edit mode after two minutes. Your Carmanah Distributor can also configure the M650 GPS so that entering a Passcode is not required. Contact your distributor for details.

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NOTE If you enter an incorrect Passcode, the word “Fail” briefly displays. This indicates that:

- The Passcode was entered incorrectly, or
- The Passcode has been changed from the default setting (753) using the 650 Device Manager software.

NOTE As a security measure, your distributor can limit which settings can be edited using the OBUI. If you are unable to edit a setting using the OBUI, contact your Carmanah Distributor for assistance.

Editing the Flash Code

If you need to change the Flash Code (for example, when you have to move an M650 GPS from one buoy to another), use the following procedure:

1. Press the **set** button until the words **Pass Code** appear on the OBUI display.
2. Enter the Passcode to log in to the M650 GPS.
3. After logging in, the word **FLSH** appears on the display.
4. Press and hold the **set** button for approximately two seconds until the Flash Code setting appears in the display with the first digit flashing.
5. Use the **up** and **down** arrows to change the first digit, and press the **set** button briefly to advance to the next digit. For a list of commonly-used Flash Codes, refer to Appendix F.
6. Change each of the three digits using the same procedure.
7. When you are finished and the new Flash Code shows on the display, press and hold the **set** button for approximately one second. The code flashes three times quickly to indicate that the new Flash Code has been set. The M650 GPS will then demonstrate the new flash code for one minute.

NOTE If programmed in a dim location, the M650 GPS will continue to flash after one minute has elapsed.

NOTE Changing the Flash Code may reduce the effective intensity setting, if the new Flash Code cannot operate in a sustainable manner at the programmed effective intensity in the programmed installation environment.

If you program a Flash Code that requires a lower Effective Intensity setting than is currently programmed, then after accepting the new Flash Code, the display indicates the new maximum Effective Intensity, and allows it to be edited (unless the user doesn't have edit access to Effective Intensity, in which case it will program the maximum allowable Effective Intensity).

Editing the Effective Intensity

The effective intensity of the lantern is a measure of its apparent brightness, and has units of candela. It takes into account the programmed Flash Code.

To change a lantern’s effective intensity:

1. Press the **set** button until the words **Pass Code** appear on the OBUI display.
2. Enter the Passcode to log in to the M650 GPS.
3. After logging in, press the **up** or **down** buttons until the word **Int** appears on the display.

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4. Press and hold the **set** button until the intensity setting starts flashing

5. Press the **up** or **down** buttons until the correct effective intensity appears on the display.

6. Press the **set** button for approximately one second to store the change.

NOTE The range of allowable effective intensities changes based on the programmed installation latitude and longitude and the Flash Code. The M650 GPS does not allow you to select an intensity which consumes more energy than is available from the solar panel in the programmed installation location.

NOTE The maximum allowable effective intensity may automatically change as you program different Flash Codes. The M650 GPS automatically calculates a new upper limit on effective intensity based on the new Flash Code and installation location latitude and longitude.

Editing the Automatic Light Control (ALC) mode

When ALC mode is set to **on**, the M650 GPS monitors the Battery Pack's state of health and reduces the intensity level if the M650 GPS is not receiving sufficient solar energy to maintain the Battery Pack.

If the M650 GPS's latitude and longitude are set correctly, ALC only reduces the intensity setting for the lantern in unusually poor solar conditions.

To toggle the ALC setting:

1. Press the **set** button until the words **Pass Code** appear on the OBUI display.

2. Enter the Passcode to log in to the M650 GPS.

3. After logging in, press the **up** or **down** buttons until **ALC** appears on the display.

4. Press and hold the **set** button until the current state of the ALC flashes (either **on** or **off**).

5. Press the **up** or **down** buttons to toggle ALC to **off** or **on**.

6. Press the **set** button for approximately one second to store the change.

NOTE Set the ALC to **off** if your application demands that the M650 GPS meets specific intensity requirements.

NOTE Leaving the ALC on provides prolonged Battery Pack life in the event of unusually poor weather over an extended period of time, or excessive bird fouling of the solar panel. When ALC intervenes, the LED's brightness is reduced.

Editing the Date

The M650 GPS has an internal clock which it uses for logging activity. The current date is written in non-volatile memory, so if the Battery Pack is unplugged or becomes completely discharged, but you reconnect or replace the Battery Pack within a few hours, the date remains correct. However, if the M650 GPS is left without power for more than a few hours, you may need to reset the date.

To edit the date on the M650 GPS:

1. Press the **set** button until the words **Pass Code** appear on the OBUI display.

2. Enter the Passcode to log in to the M650 GPS.

3. After logging in, press the **up** or **down** buttons until "**date**" shows on the display.

4. Press and hold the **set** button until the current year is flashing on the display.

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5. While the year displays, press the **up** or **down** button to change it.

6. Press the **set** button briefly. The month starts to flash on the OBUI display.

7. While the month displays, press the **up** or **down** button to change it.

8. Press the **set** button briefly. The day starts to flash on the OBUI display.

9. While the day displays, press the **up** or **down** button to change it.

10. Press the **set** button for approximately one second to store the new date.

GPS

The M650 GPS attempts to receive satellite signal lock every 10 minutes during the night and every 45 minutes during the day. The GPS status indicates the current state of the GPS receiver:

GOOD: GPS Satellite signal found and locked on.

PAUS: GPS function paused to conserve energy. This occurs unders these conditions:

- Flash Code 000 (Off)
- Flash Code 001 (Steady On - no flashing)
- Ship Mode
- 24-Hours Shutdown
- Low Battery Disconnect
- Rotary switch turned off (Switched Models)

Srch: Searching for GPS satellite signal

nLoc: No lock on GPS satellite signal. Search resumes every 10 minutesBattery Pack health status. (pg. 21)

vBat

vBat (which looks like "uBat" on the OBUI display) displays the actual battery voltage in millivolts. For example, if the battery is 4.225 volts, the display would show "4225".

Resetting to Initial Settings

Resetting to Initial Settings returns the M650 GPS's configuration to the most recent settings.

1. Press the **set** button until the words **Pass Code** appear on the OBUI display.

2. Enter the Passcode to log in to the M650 GPS.

3. After logging in, press the **up** or **down** buttons until the word **RSET** appears on the display.

4. Press and hold the **set** button until the word **no** flashes.

5. Press the **up** or **down** buttons until the display changes to **yes** (to restore the Distributor-programmed defaults) or **no** (to leave the settings as they are).

Self-Test Function

The M650 GPS lantern's BIST (Built-In Self Test) is an advanced troubleshooting function. Please contact either your distributor or Carmanah Customer Service for guidance on using and interpreting the results of the self-test function.

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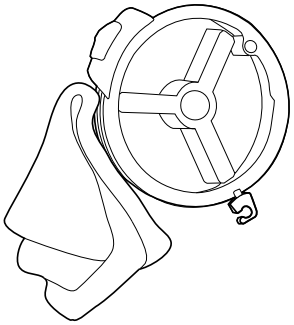
Installing the Bottom Cover

The double o-ring seal can make the bottom cover difficult to install. Take your time, and ensure the cover goes in straight, and is properly seated before you start turning it. Press down firmly on the cover as you turn it to avoid cross-threading it.

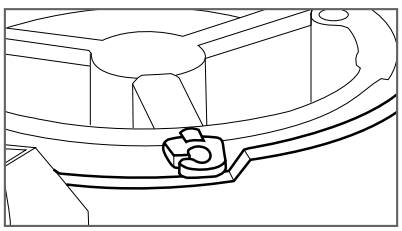
After you have completed configuring the M650 GPS using the OBUI, you must install the Bottom Cover:

1. Make sure that the two o-rings in the Bottom Cover are in place, are clean, and in good condition. Ensure that the inside surfaces of the M650 GPS that the o-rings will contact are also clean.

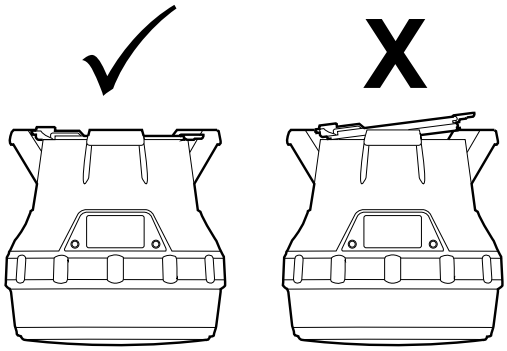


2. If the Bottom Cover was difficult to remove, apply a very thin coating of silicone o-ring lubricant to the two o-rings on the Bottom Cover before installing it.

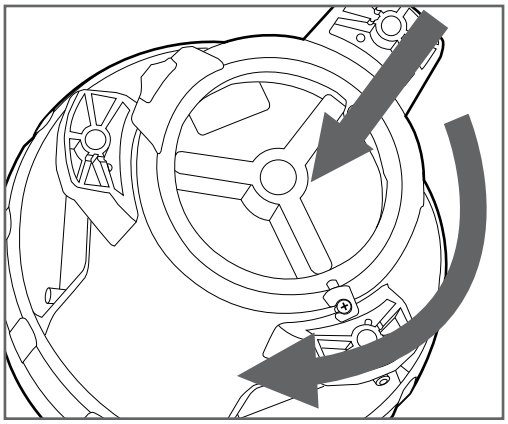
3. To install the Bottom Cover, align it so that the protruding locking tab is aligned with the small angled wall in the lantern chassis.



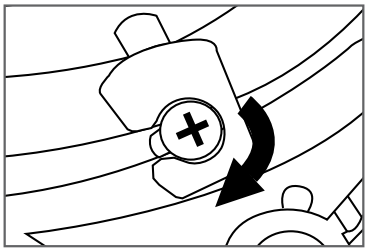
4. Push down firmly and evenly until the Bottom Cover is seated in the chassis.



5. While ensuring that the Bottom Cover stays fully seated, turn the Bottom Cover clockwise, while pressing down slightly, until the locking tab lines up with the locking screw.



6. (Optional) Tighten the locking screw to lock the cover in the installed position.



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650 Device Manager Software

Before deploying and installing the M650 GPS, you can connect it to a computer (using a USB cable) and use the 650 Device Manager software to:

- Configure the lantern's parameters
- View detailed information about the lantern
- Change Day to Night and Night to Day transition settings
- Change the passcode

Distributors also have access to a suite of advanced features.

For instruction on how to use the 650 Device Manager Software, see Appendix A.

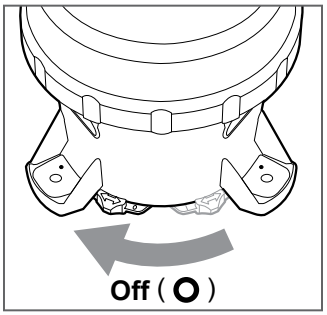
On/Off Switch

You can place the M650 GPS in one of three modes using the **On/Off** switch:

Off Mode

In **Off Mode**, the M650 GPS's main LED will not illuminate at night. During the day the M650 GPS will continue to charge its Battery Pack through the solar panel. The GPS receiver will enter the "Pause" state to conserve power.

To place the M650 GPS in **Off Mode**, move the On/Off switch to the **Off** position. The word "OFF" flashes three times on the display. While in **Off Mode**, the M650 GPS continues to charge its battery pack when exposed to light, but it will not respond to any infrared programming instructions.



NOTE

If your M650 GPS is not equipped with the optional On/Off switch, you can set it to **Off Mode** by setting the Flash Code to **000** (page 14) using the OBUI or IR Remote. When set to **Off Mode** in this manner, the M650 GPS still responds to infrared commands.

Standard On Mode

In **Standard On Mode**, the M650 GPS's main LED illuminates at dusk (using its programmed Flash Code and effective intensity), remains on all night, and turns off at dawn. The M650 GPS continues to cycle in this dusk-to-dawn mode as long as the switch remains in the **On** position. When switched to **Standard On Mode**, the display will scroll through a Status Report.

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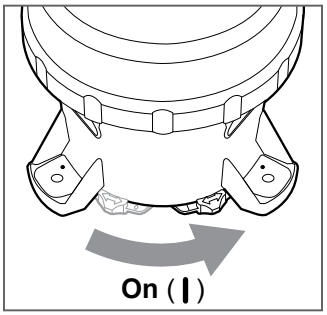
While in **Standard On Mode**, the M650 GPS continues to charge its batteries when exposed to light.

To place the M650 GPS in **Standard On Mode**, switch the On/Off switch to the **On** position. The GPS receiver will exit the "Pause" state and attempt to find and lock onto a GPS satellite timing signal.



- If you change the M650 GPS to **Standard On Mode** during the night, the main LED illuminates at the programmed Flash Code and intensity, and remains on until dawn.

- If you change the M650 GPS to **Standard On Mode** during the day, the M650 GPS's main LED illuminates for 60 seconds at the programmed Flash Code and intensity (to confirm that **Standard On Mode** was accepted), turns off, and then illuminates at dusk.

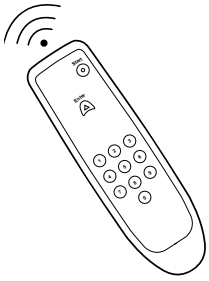
Fog Mode

With the use of the 650 Device Manager software, you can configure the M650 GPS to operate in **Fog Mode** when the On/Off switch is in the **On** position.

While in **Fog Mode**, whenever the On/Off switch is moved from the **Off** to the **On** position the M650 GPS's main LED immediately illuminates (at its programmed Flash Code and intensity), regardless of ambient light conditions. The M650 GPS remains illuminated for the rest of that day and night, turns off at dawn the next day, and then operates in **Standard On Mode**.

The difference between **Fog Mode** and **Standard On Mode** is that when the switch is put into the **On** position with the lantern configured to operate in **Fog Mode**,
the M650 GPS turns on and remains on for the rest of that day.

Infrared Remote Programmer (Optional)



The (optional) Infrared Remote Programmer (IR Remote) allows you to perform certain basic programming functions without having to remove the M650 GPS from its installed location. The IR Remote allows you to quickly access the following functions without removing the bottom cover:

- Check the Battery Pack status
- Change the Flash Code
- Put the M650 GPS into Ship Mode
- Remove the M650 GPS from Ship Mode
- Enter **Off** mode

For instructions on how to use the IR Remote, see Appendix B.

NOTE

If you set the M650 GPS to **Off** mode (Flash Code **000**) using the OBUI, the M650 GPS still responds to infrared commands.

Infrared commands are ignored if:
1. 650 Device Manager is connected.
2. The battery is dead or missing.
3. The M650 GPS switch is in the Off position.

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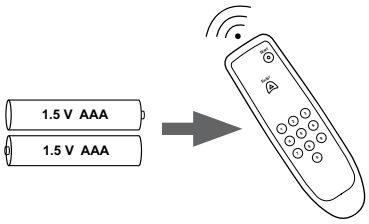
NOTE The IR remote requires 2 AAA (1.5 V) batteries.



NOTE Previous versions of the Carmanah IR Remote will work with the M650 GPS.

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Battery Pack

Battery Pack Health Status

The M650 GPS periodically monitors the health of its Battery Pack. There are three Battery Pack health status levels:

Good: the Battery Pack is healthy and charged. A Battery Pack with this health status is ready for deployment.

Charge: the Battery Pack needs to be charged, but is otherwise healthy.

Bad: the Battery Pack is damaged and should be recycled and replaced with a new one.

You can determine the Battery Pack health status using any of the four User Interface methods: the OBUI (via the buttons), the OBUI (via the On/Off switch), the IR Remote, or the 650 Device Manager software. The following table indicates how the different User Interface methods report the three levels of Battery Pack health.

Battery Pack Health Status

User Interface	Good	Charge	Bad
OBUI	“good”	“chrg”	“bad”
IR remote (flash response to query)	10 flashes	7 flashes	4 flashes
650 Device Manager	“Good”	“Charge”	“Replace”

NOTE

When installing a new battery, press and hold the **Set** button as you insert the battery connector into the M650 GPS receptacle. Continue to hold the **Set** button until **Zero** is displayed briefly. This resets the M650 GPS’s Battery Pack health monitor. Do not hold the Set button while reconnecting a used battery.

NOTE

The most accurate Battery Pack Health Status reading is obtained when the M650 GPS has been in a dark location and in off mode for at least 24 hours.

Charging the Battery Pack

Solar Charging

The easiest way to charge the Battery Pack is to put the M650 GPS in a sunny location. The M650 GPS charges automatically whenever it is exposed to sufficiently intense light. The M650 GPS’s charging system continuously monitors solar conditions, and uses a sophisticated Maximum Power Point Tracking (MPPT) algorithm to automatically adjust charging parameters to most efficiently charge the Battery Pack. The M650 GPS charging system avoids overcharging of the Battery Pack, maximizing its life.

Optional Plug-In Charger

The optional Plug-In Charger allows you to quickly charge the M650 GPS Battery Pack. The Plug-In Charger automatically charges the Battery Pack. Like the on-board charging system, the Plug-In Charger avoids overcharging the Battery Pack to prolong its life.

Charge the Battery Pack in a well-ventilated, cool spot.

Do not attempt to recharge a bad battery pack with the Optional Plug-In Charger. Damage to the Plug-In Charger may result.

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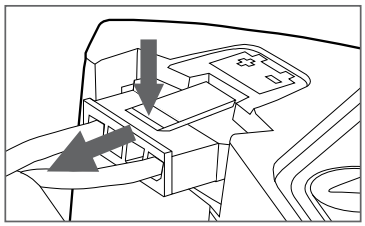
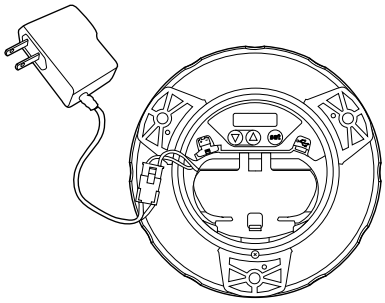
To use the Plug-In Charger:

1. Remove the Bottom Cover.

2. Unplug the Battery Pack connector by pressing down on the latch while gently pulling on the connector body. **Do not pull by the wires.**



3. Plug the charger connector into the Battery Pack connector (not into the M650 GPS body).



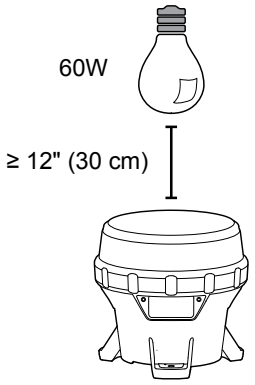
4. Plug the charger into a wall receptacle. Charging a fully discharged Battery Pack with the Plug-In Charger for five hours brings the Battery Pack to a 90% charge.

Charging with an Artificial Light Source

You can also charge the M650 GPS Battery Pack by placing the M650 GPS under an artificial light source. However, this method is considerably slower than either solar or plug-in methods.

Keep the following points in mind when charging in this manner:

- Do not use fluorescent lighting to charge the M650 GPS. Using fluorescent lighting does not damage the M650 GPS, but it does not produce enough solar energy to charge the Battery Pack.
- Different light sources produce different charging times, depending on the source wattage and spectral characteristics.
- Do not place the light source too close to the M650 GPS solar panel, as very high temperatures can damage the lantern. For example, do not place the M650 GPS closer than 12” (30 cm) to a 60 Watt light source.



NOTE

Whenever possible, use a fan to blow cool air across the M650 GPS solar panel when charging under artificial light. This both maximizes the life of the Battery Pack, and accelerates the charging process.

Preserving Battery Pack Health

The M650 GPS Battery Pack gets charged during the day, and depletes during the night by driving the main LED. Over several years the Battery Pack will degrade and require replacement. Several factors contribute to the M650 GPS Battery Pack life:

- How sunny the installation location is: choose a sunny, shade-free location.
- How hot the installation or storage location is: choose a cool area, where possible.
- Intensity setting: don’t set the lantern to be brighter than conditions require. A brighter light setting cycles the battery deeper and shortens its lifespan.
- Storage time: the longer an M650 GPS Battery Pack is stored without being charged, the shorter its life.
- Battery Pack age: over a period of many hundreds of charge/discharge cycles, the Battery Pack chem-

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istry degrades. The M650 GPS Battery Pack can last over five years, depending on the factors listed above.

Storage Procedures

Please follow these storage procedures to maximize the M650 GPS Battery Pack life:

- Prior to storage, put the M650 GPS into Off Mode (pg. 18), Ship Mode (pg. 27), or disconnect the Battery Pack (pg. 23).
- Store in a cool place.
- Follow the recharge interval recommendations presented in the following table:

Battery storage and recharge intervals

Storage Temperature ˚C	Storage Temperature ˚F	Recharge Interval (months)
≤ 20	≤ 68	9
25	77	6
30	86	4
35	95	2.5
40	104	1.5
≥ 45	≥ 113	1

Do not store the M650 GPS for long periods without charging the Battery Pack, either with the optional Plug-In Charger (pg. 21), or by placing it in the sun until the reported Battery Pack health is Good. The amount of time it takes to charge in the sun depends on the installation location, weather, and the initial Battery Pack state of health.

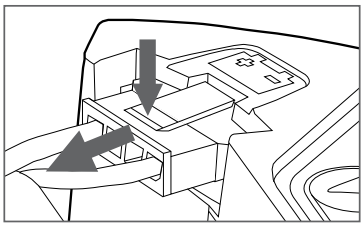
Replacing the Battery Pack

At the end of the M650 GPS Battery Pack's life, you can remove it and replace it. Always recycle used Battery Packs appropriately.

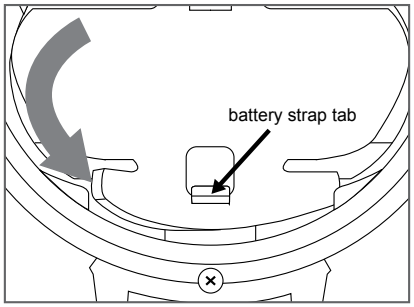
To remove the Battery Pack:

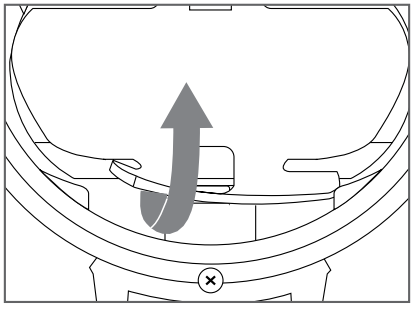
1. Remove the Bottom Cover (pg. 11).
2. Unplug the Battery Pack connector by pressing down on the latch while gently pulling on the connector body. **Do not pull by the wires.**

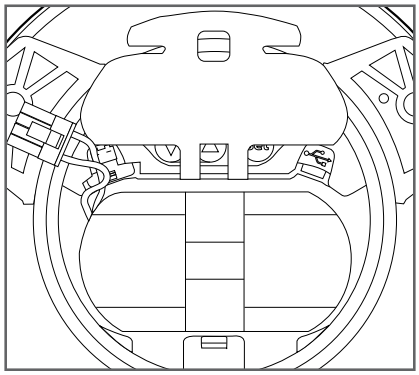
NOTE Disconnect the USB cable and Battery Pack connector before removing the Battery Pack.



3. Unhook the Battery Pack strap from the tab in the chassis, and pull the Battery Pack strap out of the way.







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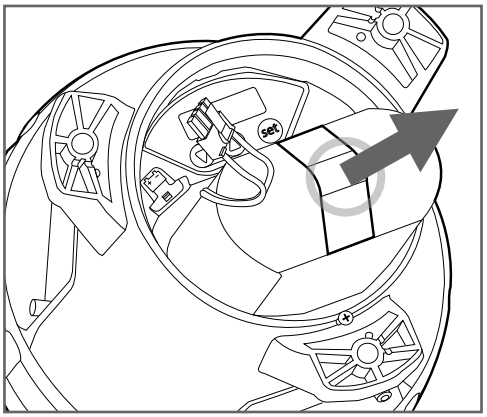
4. Insert a finger under the Battery Pack ribbon, and lift the Battery Pack out. Be careful not to pinch any wires between the Battery Pack and the housing body.



To install the Battery Pack, follow the steps above in reverse. Take care not to pinch any of the wires when seating the Bottom Cover after inserting a new Battery Pack.

NOTE

When installing a new battery, press and hold the **Set** button as you insert the battery connector into the M650 GPS receptacle. Continue to hold the **Set** button until **Zero** is displayed briefly. This resets the M650 GPS's Battery Pack health monitor. Do not hold the Set button while reconnecting a used battery.

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Maintenance

After installation, the M650 GPS requires no day-to-day maintenance.

On occasion, you may want to inspect the M650 GPS to ensure the solar panel has not been fouled by birds or covered in debris.

You can clean an M650 GPS with water and a mild detergent. Avoid any harsh detergents. Pressure washing is a convenient way to clean the M650 GPS, and won't cause damage to the lantern. Follow the guidelines below to pressure wash the M650 GPS:

- Use a 40° nozzle (white)
- Do not exceed 2900psi
- Keep the nozzle at least 6" (15cm) away from the M650 GPS

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Recycling

The Battery Pack

When the M650 GPS reports the Battery Pack's Health as "bad", the Battery Pack should be removed from the M650 GPS and replaced with a new Battery Pack. Consult carmanah.com or your Carmanah dsitributor.

Bring the used Battery Pack to a lead-acid battery collection, or appropriate recycling facility. DO NOT dispose of it in the garbage.

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Shipping

Ship Mode

Before shipping an M650 GPS, you should place it in **Ship Mode** using either the IR Remote or the 650 Device Manager software.

- Refer to page 59 for instructions on how to place the M650 GPS into **Ship Mode** using the IR Remote.
- Refer to Appendix A for instructions on how to place the M650 GPS in **Ship Mode** using the 650 Device Manager software.

After the M650 GPS enters **Ship Mode**, place it into the box in which it is being stored or shipped, and close the lid to ensure it stays in darkness. The main LED remains off until the M650 GPS is removed from the box and senses a day-to-night transition. It then continues to operate in **Standard On Mode**.

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Appendix A: 650 Device Manager Software

With the 650 Device Manager (650DM) software installed on your computer, you can:

- Configure the M650 GPS's parameters.
- View detailed information about the lantern.
- Change Day to Night and Night to Day transition settings.
- Change the passcode(s)

Distributors also have access to a suite of advanced features.

System Requirements

The M650 GPS requires an updated (version 2) copy of the 650 Device Manager software. You can download version 2 from the Carmanah Partner Portal (login required). To run the 650DM software, your computer must meet the following requirements:

Hardware Requirements

- Pentium II processor, or higher
- 250 MB free disk space (if .Net framework not yet installed on the computer)
- 50 MB free disk space (if .Net framework already installed)
- 32 bit colour, 1024 X 768 minimum resolution
- One available USB port
- One USB cable

Software Requirements

- Windows 7
- Windows XP, Service Pack 2 or 3

NOTE If your computer already has the .Net framework installed, the 650 Device Manager will install in a few seconds. If the .Net framework is not installed, installation will take between 5 and 10 minutes.

Installation Procedure

If your system meets the system requirements outlined in the previous section, install the 650 Device Manager by following the steps below.

1. Double-click the installation icon. The *650 Device Manager* installation screen appears.

650 Device Manager 1.4.3560
650 Device Manager 1.4.3560
Publisher: Carmanah Technologies Corp.
Web site: http://www.carmanah.com
Email address: customerservice@carmanah.com
InstallMate will install or upgrade 650 Device Manager on your computer.
Click Next to continue.
Copyright © 2012
This program is protected by copyright law and international treaties. Unauthorized reproduction or distribution of this program, or any portion of it, is a violation of applicable laws.
About...
< Back
Next >
Cancel

2. Click **Next**. The *License Agreement* appears.

650 Device Manager 1.4.3560
License agreement
Please read the license agreement carefully before continuing.
CARMANAH TECHNOLOGIES CORP.
650 DEVICE MANAGER – END USER LICENSE
April 2, 2012 – Version 1.0
IMPORTANT: This legal document is an agreement between you or your organization (the "Licensee") and Carmanah Technologies Corp. ("Carmanah")
ACCEPTANCE: By installing this software, the Licensee confirms acceptance of the following terms and conditions.
I agree to these terms and conditions
< Back
Next >
Cancel

3. After reading the *License Agreement*, check the checkbox in the bottom left corner of the window and click **Next**. The *Installation options* window appears.

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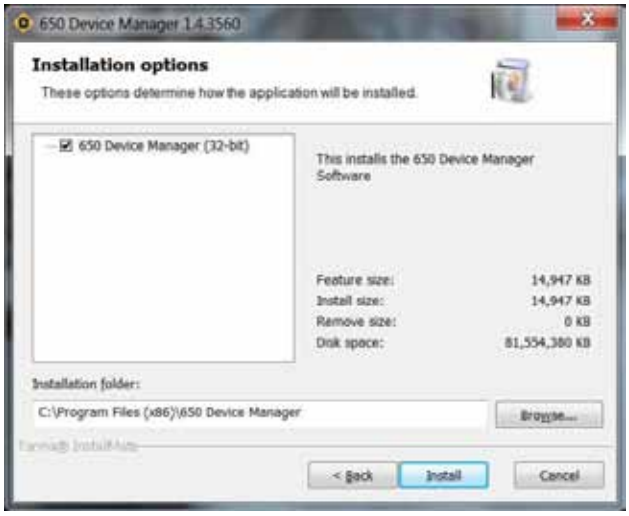


4. If you approve of the default installation folder, click **Install**. If you prefer to install 650 Device Manager in another folder, click **Browse**, navigate to the correct folder, then click **Install**.

NOTE If your computer doesn't have the .Net framework installed, it will be installed now. This process can take between 5 and 10 minutes; please wait while it installs.

After the installation is complete, the *Installation completed* window appears.

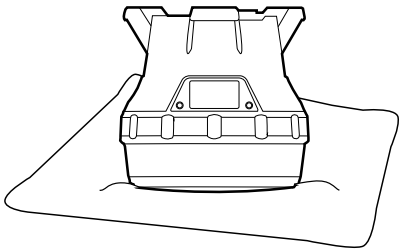
Congratulations, you have successfully completed your 650 Device Manager installation.

NOTE If you have the older version 1 of 650 Device Manager installed, the new version 2 will detect it and offer to uninstall it automatically before installing the new version 2.

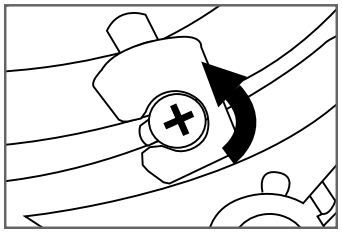
Removing the Bottom Cover

Before you can connect the USB cable to the lantern, you must remove the lantern's Bottom Cover. To do this:

1. Turn the lantern upside down and place it on a soft cloth (to avoid scratching the housing).



2. Locate and turn the locking screw counter-clockwise to loosen it (you do not have to remove the locking screw).



3. Secure the lantern so it won't move, and then firmly twist the Bottom Cover counter-clockwise until it stops.

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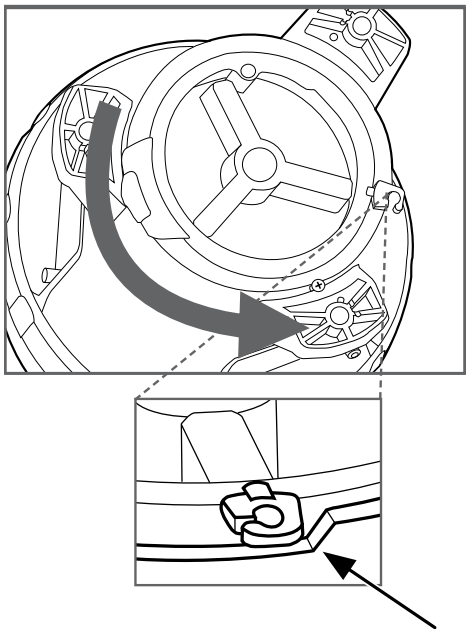
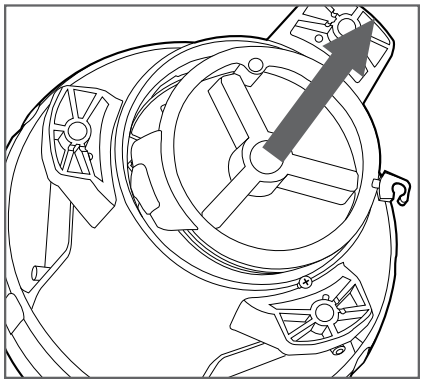
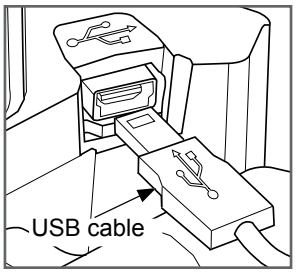


4. Lift the cover out using the protruding locking tab. You can now access the USB connector port (for using the 650DM software).



5. Using the USB cable provided with your 650 Device Manager software, connect the larger end to an available USB connector in your computer. Connect the other smaller end to the USB connector inside the M650 GPS.



Logging In

To login to the 650DM software:

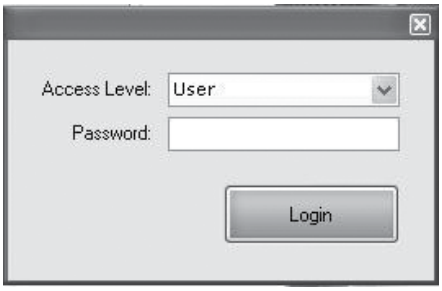
1. From either the **Start/Program** menu or your Windows Desktop, click **650 Device Manager**.

   The *650 Device Manager Status* screen appears.

2. From the *650 Device Manager Status* screen, click **Login Here**.

The *Login* dialog box appears.

NOTE You can disconnect your USB cable from a lantern and reconnect to another lantern without logging out of the 650DM. The 650DM will take a few seconds to connect to the new lantern.



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3. In the *Access Level* field, select **User** from the drop down menu. The default User Access Level password is **1Cmh2**

NOTE You will only have access to the software functions associated with the Access Level at which you log in. (Distributor and Manufacturing Access Levels are able to modify a wider range of lantern parameters.)

4. Enter the **Password** and click **Login**.

If you've connected an M650 GPS lantern to your computer using a USB cable, then after a short pause, the 650DM software connects to the lantern, and a coloured picture of the M650 GPS on the main screen replaces the darkened picture. The picture that appears matches the LED colour of the M650 GPS.

Once you successfully login, several of the buttons in the *Bottom Bar* become active. Inactive buttons display with white text.

User Functions

The procedures in the following section are available to all Access Levels (User, Distributor and Manufacturing). "Top Bar", "Function Page", and "Bottom Bar" are identified in the image following:

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The following section describes the various parts of the 650 Device Manager screen:

TOP BAR	The *Top Bar* is the blue area at the top of the window. It always contains the following information boxes:
	Battery Health: This gives you a quick snapshot of the battery's current state of health: **Good:** the Battery Pack is healthy, and charged. A Battery Pack in this state is ready for deployment. **Charge:** the Battery Pack needs to be charged, but is otherwise healthy. **Replace:** the Battery Pack should be recycled, and replaced with a new one. **Ship Mode:** This indicates if the lantern is currently in Ship Mode (e.g. Ship Mode: On). **Disconnected/(Model Name) Connected:** This indicates the 650DM connection status. If your computer is not connected to a lantern, it displays **Disconnected**. When connected to a lantern, it displays the lantern's **model name**. **Login Here/Logout (Access Level):** Click this button to log out of 650DM. The name in brackets indicates the access level of the user currently logged in to the device (User, Distributor, or Manufacturing).
FUNCTION PAGE	The centre area of the screen contains the *Function Page* information. Different content appears in this area, depending on the button you select from the Bottom Bar.
BOTTOM BAR	The *Bottom Bar* contains buttons that allow you to access the software's various function pages. As a User, you can access the following pages:
	Status: (the default page when you log in): This page contains basic status information about the M650 GPS that is currently plugged into the computer. **Configuration:** This page displays the attached lantern's current configuration, and allows you to change various settings (for example, Flash Code and Effective Intensity). **SW Admin:** This page has two tabs: the *Connection Tab* (which allows you to view your current Connection Status, Com Port address, and 650DM version number), and the *Security Tab* (which allows you to change passwords). **Exit:** Click **Exit** to end your current session and close the 650DM software.

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Checking the Lantern's Status

After logging in to 650DM as a User, the *650 Device Manager Status Page* appears. This section describes the various functions of the *Status Page*.

NOTE The *Status Button* highlights in yellow in the *Bottom Bar*.

Status Page

After logging in to 650DM, the 650 Device Manager Status Page appears. The following are the various functions of the Status Page.

AREA NAME	DESCRIPTION
Device Information Area The Device Information Area contains the following information:	**Model #:** the lantern's model number. **Serial #:** the lantern's serial number. **Date of Manufacture:** the date the lantern was manufactured. **LED Colour:** the colour of the LED in the lantern. **Device Date/Time:** the date and time currently programmed on the lantern.
Firmware and Flash Code Table Version The Firmware and Flash Code Table Version area contains the following information:	**Firmware Version:** the current firmware version loaded onto the lantern. **Flash Code Table Version:** the version of the Flash Code Table that is currently loaded on the lantern.

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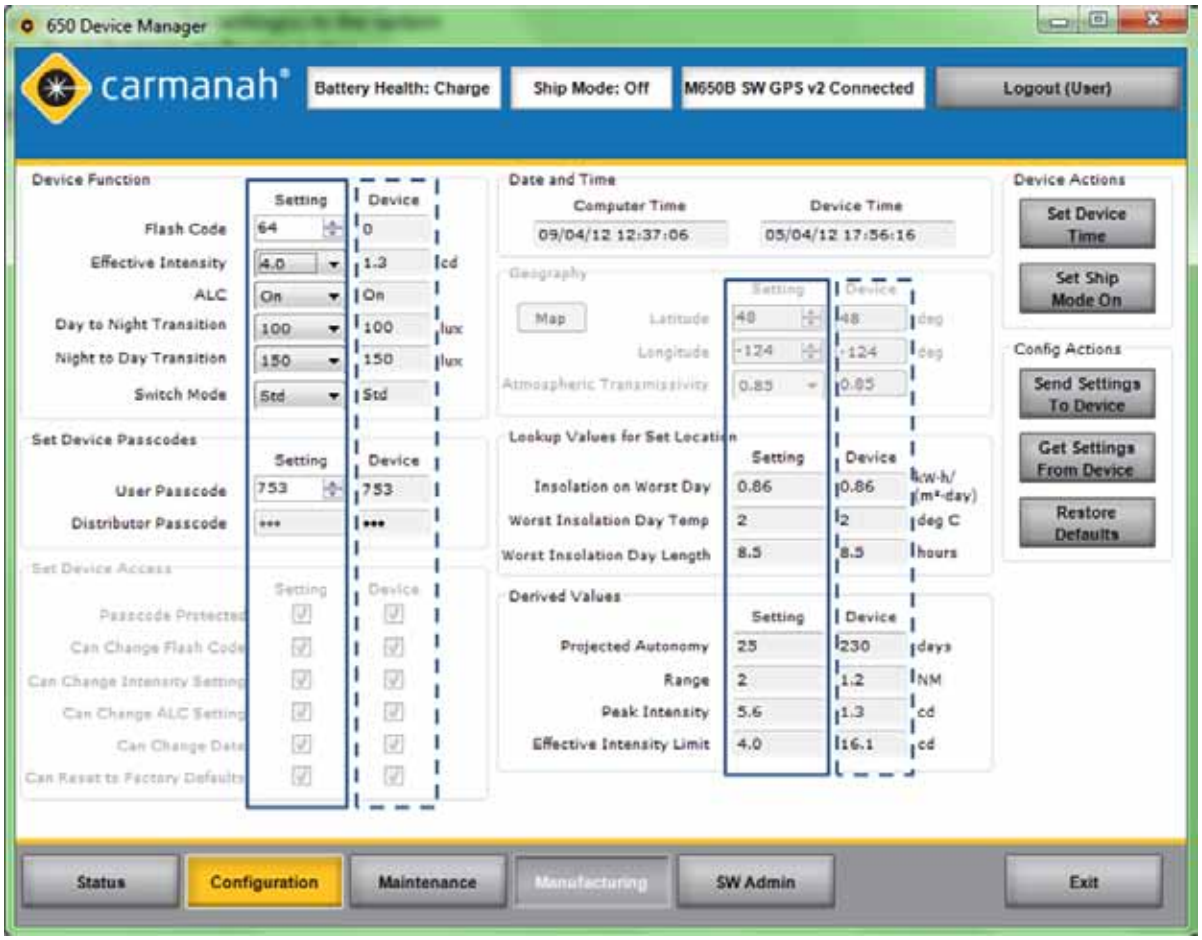
Configuration Page

The *Configuration Page* displays the lantern's current settings, and allows you to modify some of these settings. The columns under the "Setting" headings (the *Setting Columns*, shown in solid-line boxes below) indicate the 650DM's current setpoints. The columns under the "Device" headings (the *Device Columns*, shown in dashed-line boxes below) show the connected lantern's settings.

The general method for changing a setting involves changing the 650DM setpoint(s) in the *Setting Columns* and then sending the setting(s) to the lantern using the **Send Settings to Device** button.

NOTE A User cannot edit the *Geography* or the *Set Device Access* areas.



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The following fields are available on the Configuration Page:

AREA NAME	DESCRIPTION
Device Function	**Flash Code:** Either type in the correct Flash Code, or click the up and down arrows to select the correct Flash Code. Refer to Appendix F for more information. **Effective Intensity:** Either type in the desired Effective Intensity setting, or click the down arrow and select the Effective Intensity setting from the drop-down menu. For more information about Effective Intensity, see the Derived Values section of this table, below. **ALC:** Click the down arrow and select On (to enable ALC) or Off (to disable ALC). For more information about ALC, refer to page 15 of the User Manual. **Day to Night Transition Level:** Either type in the correct Day to Night Transition Level (D2N) setting, or click the down arrow to select the correct D2N Transition Level setting. For more information about the D2N Transition Level, refer to the table on page 39. **Night to Day Transition Level:** Either type in the correct Night to Day Transition Level (N2D) setting, or click the down arrow to select the correct N2D Transition Level setting. For more information about the N2D Transition Level, refer to the table on page 39. **Switch Mode:** If the lantern is equipped with the optional external switch, you can change the Switch Mode between Standard Mode (Std) and Fog Mode (Fog). For more information about the Switch Mode, refer to the table on page 40.
Set Device Passcodes	**User Passcode:** This is the passcode that users enter when logging into a lantern using the On-Board User Interface (OBUI). You can edit the passcode by typing in the desired setting, or using the up/down arrows. **Distributor Passcode:** This field is only editable by someone logged in at the Distributor or Manufacturing Access Level.
Date and Time	**Computer Time:** This is the current date and time, synchronized with the computer on which the 650DM is installed. **Device Time:** This is the time currently configured on the lantern. To synchronize the time of a connected lantern to the computer time, click Set Device Time.
Derived Values	**Projected Automomy:** This indicates the estimated number of days of dusk-to-dawn operation the lantern can sustain without any solar energy being gathered by the solar panel. The Projected Autonomy changes to reflect any changes to the Flash Code, Effective Intensity, and Transition light level settings. **Range:** This is the range of the lantern, in nautical miles, when programmed with the current settings. It is calculated using the methods outlined in IALA E-122, Section 1.5. **Peak Intensity:** This is the intensity of the lantern, in candela, when the LED is on. The Peak Intensity value, unlike the Effective Intensity value, does not take into account the programmed Flash Code: it is the instantaneous intensity of the lantern during the “on” portion of the Flash Code.

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	Effective Intensity Limit: This is the maximum Effective Intensity which can be programmed without exceeding the available solar energy. This prevents the lantern from being deployed at a setting which isn't sustainable. Factors that influence the Effective Intensity Limit include: Flash Code, Day to Night and Night to Day Transition, Latitude and Longitude, and Atmospheric Transmissivity. The Effective Intensity of a flashing light is the intensity that a steady-on light must have to appear equivalently bright. It is calculated using the method of Schmidt-Clausen, as per IALA E-122, Section 1.4. **NOTE** The Peak Intensity and Effective Intensity values correspond to the intensity of the beam in the horizontal plane.
Device Actions	**Set Device Time:** Click this to synchronize the computer time with the lantern time. **Set Ship Mode On:** Click this to put the lantern into Ship Mode (Set Ship Mode On), or take the lantern out of Ship Mode (Set Ship Mode Off). For more information on Ship Mode, refer to the Ship Mode section of this Appendix.
Config Actions	**Send Settings to Device:** This sends the settings currently shown in the Setting Columns to the lantern. Note that this button becomes inactive when the values in the Setting Columns would require more solar energy than is available at the programmed location (Latitude and Longitude). When this occurs, red exclamation points highlight the settings that are contributing to the energy deficit. If you put your mouse pointer over the exclamation point, a message indicates the problem. **Get Settings from Device:** Click this to retrieve the lantern's current settings and copy them into the Setting column. Note that when the 650DM connects to a lantern, it does this automatically. **Restore Defaults:** This restores the settings that were last programmed at the Distributor or Manufacturing Access Level. If the lantern's settings have only been changed at the User Access Level, the settings return to what they were when you first received the lantern.

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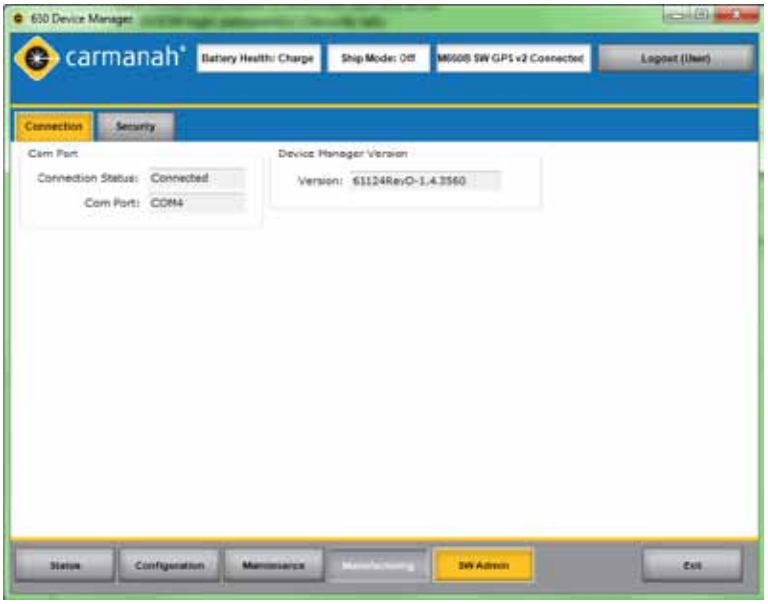
SW Admin Page

The SW Admin (Software Administration) page has two tabs that allow you to view connection and software version information (*Connection tab*) and to set the 650DM login password(s) (*Security tab*).



AREA NAME	DESCRIPTION
Connection Tab:	
Connection Status	The *Connection Status* field indicates if you are currently connected or not connected to a lantern.
Com Port	The *Com Port* field displays the current communications port through which the lantern is connected to the 650DM.
Connection Tab:	
650DM Version	This field displays the version of the 650DM currently installed on the computer.

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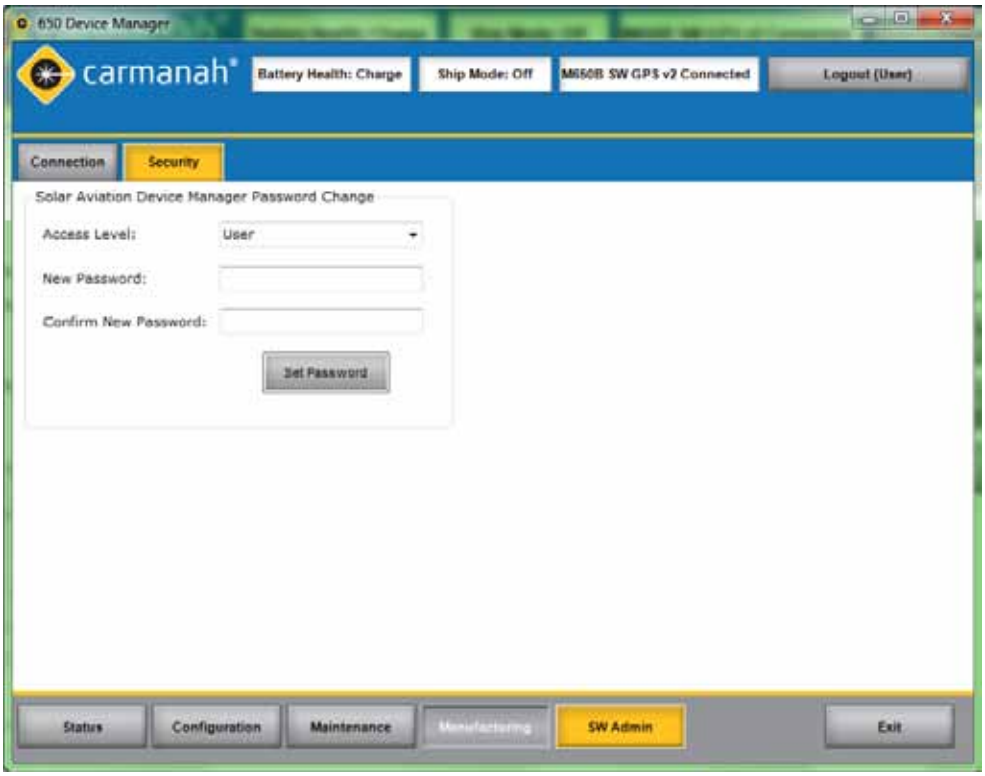

AREA NAME	DESCRIPTION
Security Tab:	
650 Device Manager Password Change	After clicking the *Security Tab*, the *650 Device Manager Password* Change area appears. This allows you to change the password that is entered when you login to the 650DM. To set a new password, select the appropriate Access Level from the Access Level drop-down menu, enter the new password in the *Password* field, and click **Set Password**. **NOTE** If you are logged in as a User, you will only see the Access Level "User". If you are signed in as a Distributor, you will see both Distributor and User.

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Initial Configuration

After receiving your lantern from a Carmanah Distributor, most of the lantern's settings should already be configured. If you want to further customize these settings, follow the associated procedure.

SETTING	DEFINITION	PROCEDURE
Flash Code	The Flash Code controls the flash pattern the lantern emits during operation. Select the appropriate Flash Code from the Flash Code Table (see Appendix F) and enter the code in this field.	Either type in the correct Flash Code, or click the up and down arrows to select the desired Flash Code.
Effective Intensity	The Effective Intensity setting controls the lantern's brightness. A higher Effective Intensity setting allows the lantern to be seen from farther away, but also uses up more battery power and requires more solar energy. The Effective Intensity setting is measured in candela, and takes into account the programmed Flash Code (using the method of Schmidt-Clausen as per IALA E-122, Section 1.4). The Effective Intensity value is measured in the horizontal plane.	Either type in the correct Effective Intensity setting, or click the down arrow and select the correct Effective Intensity setting.
ALC (Automatic Light Control)	When ALC is enabled, the lantern monitors the battery pack's state of charge and reduces the intensity level if the lantern is not receiving sufficient solar charging to maintain the battery pack. When the battery pack recovers, ALC automatically resumes operation at the programmed Effective Intensity. If the lantern's latitude and longitude are set correctly, ALC reduces the Effective Intensity setting for the lantern only under unusually poor solar conditions.	Click the down arrow and select **On** (to enable ALC) or **Off** (to disable ALC).
Day to Night Transition Level	As the sun goes down in the evening, the ambient brightness level goes down with it. The Day to Night Transition Level (D2N) is the ambient light level (measured in lux) at which the lantern's beam will turn on in the evening. A lower D2N results in the lantern turning on later, conserving battery power.	Click the down arrow and select the correct Day to Night Transition Level setting.
Night to Day Transition Level	As the sun rises, the ambient light level goes up. The Night to Day Transition Level (N2D) is the ambient light level (in lux) at which the lantern's beam turns off in the morning. A lower N2D results in the lantern turning off earlier, conserving battery power. **NOTE** The N2D setting must be at least 25 lux greater than the D2N setting	Click the down arrow and select the correct Night to Day Transition Level setting.

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Switch Mode	For lanterns equipped with the optional external switch, two Switch Modes are available. These modes control the behaviour of the lantern when switched on during the day using the external switch: **Standard Mode (Std):** If the lantern is switched on during the day in this mode, the lantern will turn on for a minute or two to demonstrate the programmed flash code and intensity, and then extinguish until the programmed D2N light level is sensed. **Fog Mode (Fog):** When switched on during the day in Fog Mode, the lantern will turn on, and remain on for the rest of that day and the following night. It will extinguish the next morning, when the N2D light level is sensed. It will then return to normal dusk-until-dawn behaviour. Fog Mode can be used to force the lantern on during the day.	Click the down arrow and select **Std** (for Standard Mode) or **Fog** (for Fog Mode).
User Passcode	The User Passcode is the 3-digit number that you must enter on the OBUI to modify the lantern's settings (unless the lantern is configured so as not to require passcode entry to edit settings).	Either type in the desired User Passcode, or click (and hold, if desired) the up/down arrows to select your preferred User Passcode.
Set Device Time	This sets the internal clock on your lantern to be the same as the time on your computer. NOTE The M650 GPS is equipped with an algorithm that uses daily transition events to periodically correct for its clock drifting over time. It's not critical that the internal lantern clock and computer times be identical; the internal lantern clock exists only for datalogging purposes.	Click this button to synchronize the time on your lantern to the time on your computer. After pressing the button, the times displayed in the *Date and Time* area should be identical.
Set Ship Mode On / Set Ship Mode Off	This allows you to set the lantern to Ship Mode. Ship Mode prevents the lantern's beam from turning on until it detects a Night to Day transition event, at which point the lantern exits Ship Mode and resumes normal operation. Use Ship Mode whenever you store the lantern somewhere where it remains consistently dark (like inside a closed box). If you don't use Ship Mode prior to placing a lantern in a consistently dark location, the lantern's beam will turn on for ~24h, at which time it will automatically enter Ship Mode. To conserve battery power, however, it's preferable to put the lantern into Ship Mode prior to dark storage.	Click this button to enter your lantern into Ship Mode. Click the button again to turn Ship Mode off. To confirm Ship Mode, look at the Top Bar.

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Send Settings To Device	Click this to send the settings currently shown in the *Setting* columns to the lantern. Note that this button becomes inactive when the values in the *Setting* columns would require more solar energy than is available at the programmed location (latitude and longitude). When this occurs, red exclamation points highlight the settings that are contributing to the energy deficit. If you put your mouse pointer over the exclamation point, a message indicates the problem.	With the lantern plugged into your computer, click the button to send the values in the *Setting* column on the *Configuration* page to the lantern.
Get Settings From Device	Click this to retrieve the lantern's current settings and copy them into the *Setting* column. Note that when 650DM connects to a lantern, it does this automatically. Use the **Get Settings From Device** button if you have modified the values in the *Setting* columns of the *Configuration* page, but don't want to send the settings to the lantern.	With the lantern plugged into your computer, click **Get Settings From Device** to populate the *Setting* columns' values with those programmed on the lantern.
Restore Defaults	This restores the settings that were last programmed . If the lantern's settings have only been changed at the User Access Level, the settings will return to what they were when you first received the lantern.	With the lantern plugged into your computer, click **Restore Defaults** to populate the *Setting* columns' values with those originally programmed on the lantern.

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User Tasks

Restoring the Default Configuration

If you accidentally change a setting while customizing your lantern's settings, you can restore the lantern to its previous configuration.

Restoring the configuration changes the following settings (if they're different from the current values): Flash Code, Effective Intensity, Automatic Light Control, Day to Night Transition, Night to Day Transition, Switch Mode, and User Passcode.

NOTE Latitude/Longitude, Transmissivity, and Distributor Passcodes won't change.

To restore the configuration:

1. Remove the lantern's Bottom Cover and plug the USB cable into the USB port.
2. Connect the other end of the USB cable to an empty USB port on your computer.
3. Open 650DM on your computer. 650DM may take a moment to find and connect to the lantern.
4. Click **Configuration** on the Bottom Bar. The Configuration screen appears.
5. Click **Restore Defaults** (on the right side of the screen). The lantern's current settings are replaced with the settings last programmed by your Distributor or Carmanah Manufacturing.

Using the Derived Values

Derived Values are calculated based on the settings you select for your lantern. The values described in the following table are calculated from the following settings: Flash Code, Effective Intensity, Day to Night Transition, Night to Day Transition, the Latitude and Longitude, and Transmissivity.

If you change any of these settings, 650DM calculates the effects of your changes on the lantern, and displays the results in the Derived Values area of the Configuration Page.

Note that until you use the **Send Settings to Device** button, the values in the *Device* columns remain unchanged. This allows you to compare the lantern's current derived values with those resulting from the settings currently entered in the *Setting* columns in the *Device Function* area.

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VALUE	DEFINITION	HOW THEY CHANGE
Projected Autonomy	This indicates the estimated number of days of dusk-to-dawn operation the lantern can sustain without any solar energy being gathered by the solar panel.	If you change any of the settings that affect the lantern's power consumption, the Projected Autonomy will automatically update to reflect that change. If a settings change results in the lantern using less power, then the Projected Autonomy value increases. If the change requires more power from the lantern, then the Projected Autonomy value decreases.
Range	This is the visible range of the lantern, in nautical miles, when programmed with the current settings. It is calculated using the methods outlined in IALA E-122, Section 1.5.	If you change the *Effective Intensity* setting, the Range value updates accordingly. If you've increased the *Effective Intensity* setting, the Range value will also increase. If you lower the Effective Intensity setting, the Range value decreases.
Peak Intensity	This is the intensity (brightness) of the beam when the LED is on. This value is expressed in candela. The Peak Intensity gives the intensity of the beam in the horizontal plane.	If you change the *Effective Intensity* setting, the Peak Intensity value updates accordingly. If you've increased the *Effective Intensity* setting, the Peak Intensity value also increases. If you lower the Effective Intensity setting, the Peak Intensity value decreases.
Effective Intensity Limit	This is the maximum Effective Intensity setting that can be programmed to the lantern without exceeding the available solar energy. This value changes with Flash Code, D2N and N2D Transition settings, and the Geography settings (Latitude, Longitude and Atmospheric Transmissivity; set by your Distributor or Carmanah Manufacturing).	If you change the *Flash Code* or *Transition* settings, the Effective Intensity Limit value updates to reflect that change. If a settings change results in the lantern using less power, then the Effective Intensity Limit value increases. If the change requires more power from the lantern, then the Effective Intensity Limit value decreases.

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Entering/Exiting Ship Mode

Ship Mode prevents the lantern's beam from turning on until it detects a Night to Day transition event, at which point the lantern exits Ship Mode and resumes normal operation. Use Ship Mode whenever you store the lantern somewhere where it remains consistently dark (like inside a closed box). If you don't use Ship Mode prior to placing a lantern in a consistently dark location, the lantern's beam will turn on for ~24h, at which time it will automatically enter Ship Mode. To conserve battery power, however, it's preferable to put the lantern into Ship Mode prior to dark storage.

NOTE After you put a lantern into Ship Mode, immediately place the lantern into a dark, sealed storage box (to prevent it from experiencing a Night to Day transition and returning to normal operation).

To put a lantern into Ship Mode (turning Ship Mode On):

1. Remove the lantern's Bottom Cover and plug the USB cable into the USB port.
2. Connect the other end of the USB cable to an empty USB port on your computer.
3. Open 650DM on your computer. 650DM may take a moment to find and connect to the lantern.
4. Click **Configuration** on the Bottom Bar. The *Configuration* screen appears.
5. Click **Set Ship Mode On** (on the right side of the screen). To confirm that the lantern is in Ship Mode, **Ship Mode: On** appears in the middle of the top bar

To take a lantern out of Ship Mode (turn Ship Mode Off):

There are three ways to restore a lantern from Ship Mode. You can take the lantern out of the storage box and place it in bright light for a few moments, followed by darkness; you can use the infrared programmer; or you can use the 650DM software as follows:

1. Remove the lantern's Bottom Cover and plug the USB cable into the USB port.
2. Connect the other end of the USB cable to an empty USB port on your computer.
3. Open 650DM on your computer. 650DM may take a moment to find and connect to the lantern.
4. Click **Configuration** on the Bottom Bar. The *Configuration* screen appears.
5. Click **Set Ship Mode Off** (on the right side of the sceen). The lantern exits Ship Mode and resumes normal operation. To confirm that the lantern is out of Ship Mode, **Ship Mode: Off** appears in the middle of the top bar..

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Setting the Time

When a lantern's battery pack is removed, the lantern's internal clock stops. When another battery pack is installed, the lantern sets its internal clock to use the last time recorded in its datalog. This may be quite close to the actual time if the lantern hasn't gone without power for long, but for a lantern that remains without a battery packconnected for more than a few hours, the internal clock should be updated using the **Set Device Time** button. To restore the lantern's clock to reflect the same time as on your computer, use the following procedure.

To set the lantern's time:

1. Remove the lantern's Bottom Cover and plug the USB cable into the USB port.
2. Connect the other end of the USB cable to an empty USB port on your computer.
3. Open 650DM on your computer. 650DM may take a moment to find and connect to the lantern.
4. Click **Configuration** on the Bottom Bar. The *Configuration* screen appears.
5. Click **Set Device Time** (on the right side of the screen). The lantern's time now matches the time on your computer. To confirm this, you can look at the Date and Time area on the Configuration page. Both the *Computer Time* and *Device Time* fields should match.

Setting the Day to Night Transition Level

The Day to Night Transition Level (D2N) is the ambient brightness (in lux), at which the lantern will turn on in the evening. A higher value for the D2N Transition Level causes the lantern to turn on earlier; a lower value causes it to turn on later.

NOTE Remember that the earlier the lantern turns on, the more battery power it consumes. Therefore, higher D2N Transition Level settings lower the Effective Intensity Limit and Projected Autonomy slightly.

To set the D2N Transition Level:

1. Remove the lantern's Bottom Cover and plug the USB cable into the USB port.
2. Connect the other end of the USB cable to an empty USB port on your computer.
3. Open 650DM on your computer. 650DM may take a moment to find and connect to the lantern.
4. Click **Configuration** on the Bottom Bar. The *Configuration* screen appears.
5. In the *Device Function* area, click the **down arrow** beside the *Day to Night Transition* field, and select the appropriate value. The *Setting* column values for Autonomy and the Effective Intensity Limit (in the *Derived Values* area), change to reflect the effect of the new D2N Transition Level.
6. Click **Send Setting to Device**. The new D2N Transition value is sent to the lantern. The values for Autonomy and the Effective Intensity Limit, in the *Device* column of the *Derived Values* area, change to reflect the effect of the new D2N Transition Level.

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Setting the Night to Day Transition Level

The Night to Day Transition Level (N2D) is the ambient brightness at which the lantern comes on in the morning (measured in Lux). A higher value for the N2D Transition Level causes the lantern to turn on later in the morning; a lower value makes it turn on earlier.

NOTE You cannot program the N2D Transition Level to be lesser value than the D2N Transition Level.

To set the N2D Transition Level:

1. Remove the lantern's Bottom Cover and plug the USB cable into the USB port.
2. Connect the other end of the USB cable to an empty USB port on your computer.
3. Open 650DM on your computer. 650DM may take a moment to find and connect to the lantern.
4. Click **Configuration** on the Bottom Bar. The *Configuration* screen appears.
5. In the *Device Function* area, click the **down arrow** beside the *Night to Day Transition* field, and select the appropriate value. The *Setting* column values for Autonomy and the Effective Intensity Limit (in the *Derived Values* area), change to reflect the effect of the new N2D Transition Level. [
6. Click **Send Setting to Device**. The new N2D Transition value is sent to the lantern. The values for Autonomy and the Effective Intensity Limit, in the *Device* column of the *Derived Values* area, change to reflect the effect of the new N2D Transition Level.

Setting the ALC

When ALC (Automatic Light Control) is enabled, the lantern monitors the battery pack's state of charge and reduces the Effective Intensity level if the lantern is not receiving sufficient solar charging to maintain the battery pack's state of charge.

If the lantern's latitude and longitude are set correctly, ALC reduces the Effective Intensity setting for the lantern only under unusually poor solar conditions.

To turn ALC off:

1. Remove the lantern's Bottom Cover and plug the USB cable into the USB port.
2. Connect the other end of the USB cable to an empty USB port on your computer.
3. Open 650DM on your computer. 650DM may take a moment to find and connect to the lantern.
4. Click **Configuration** on the Bottom Bar. The *Configuration* screen appears.
5. In the *Device Function* area, click the **down arrow** beside the *ALC* field, and select **Off** to disable ALC, or select **On** to enable ALC.
6. Click **Send Settings to Device**. Your setting change is sent to the lantern.

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Changing the 650 Device Manager Password

The 650DM software is delivered with a default login password that allows you to view and edit your lantern's configuration. Although you can continue to use the default password, you also have the option to change the 650DM password to something that is easier to remember or is more secure.

To change your 650DM Password:

1. **Open** and **login** to 650DM using your existing password. If this is the first time you are changing the password, use the default User Access Level password **1Cmh2**.

2. Click **SW Admin** on the Bottom Bar. The *Software Administration* screen appears.

3. Click the **Security** tab. The *Security* page appears.

4. In the *Access Level* field, select **User**.

5. In the *New Password* field, enter your new password. 650DM passwords are case-sensitive.

6. In the *Confirm New Password* field, re-type your new password.

7. Click **Set Password**. Your new password is now active.

Understanding the Installation Location Environmental Parameters

650DM displays information about the lantern's installation location based on its programmed geography settings (latitude, longitude, and atmospheric transmissivity). The lantern uses these parameters (among others) to calculate the lantern's Effective Intensity Limit. The calculated values appear in the *Lookup Values for Set Location* area.

The parameters that display are:

- **Insolation on Worst Day:**
  This is a measure of how much sun is available at the lantern's programmed latitude/longitude during the shortest winter day (this is measured in units of kWh/m^2day).
- **Worst Insolation Day Temp:**
  This is a measure of the lowest expected average winter temperature at the programmed latitude and longitude (in degrees Celsius). This allows for the precise calculation of the efficiency of the following hardware elements, which all vary with temperature: solar panel, battery charger circuitry, battery, LED driver circuitry, and LED.
- **Worst Insolation Day Length:**
  This is the length of the shortest day of the year at the programmed latitude.

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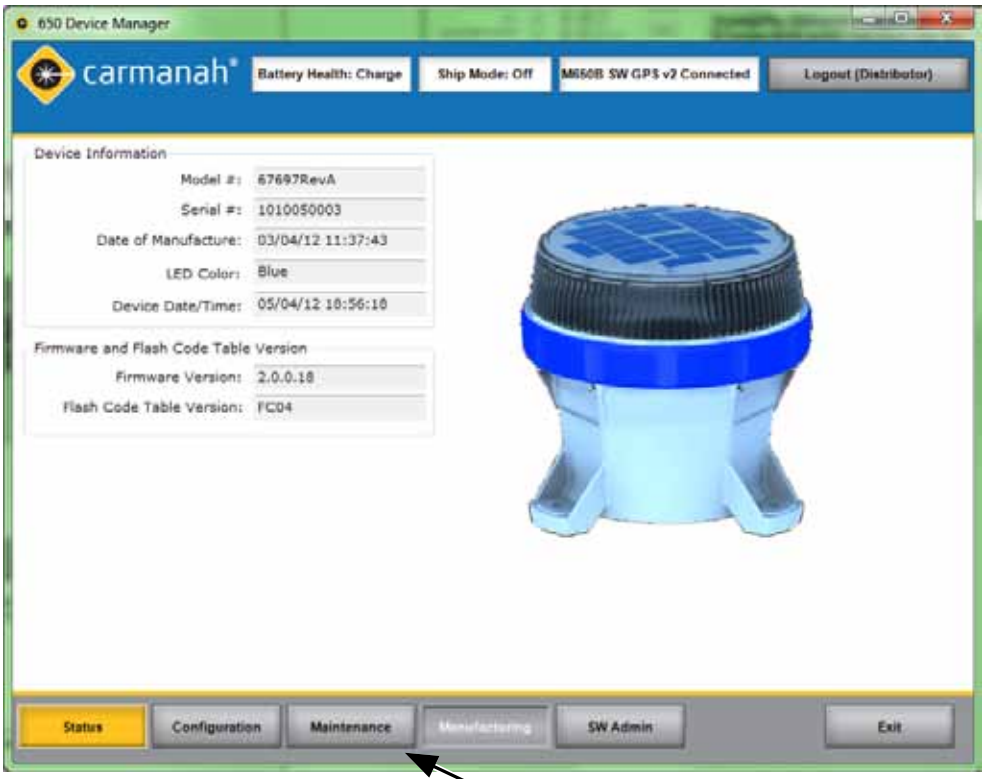
Distributor Functions

The procedures in this section are accessible to anyone with Distributor or Manufacturing access.

Logging In

When logging in as a Distributor, click **Login Here**, select **Distributor** from the *Access Level* drop-down, enter your Distributor password, and click **Login**.

After logging in as a Distributor, you will have access to the *Maintenance* page. Also, other areas of the *Configuration* page become editable.



The *Maintenance Page* is available to a Distributor, but not a User.

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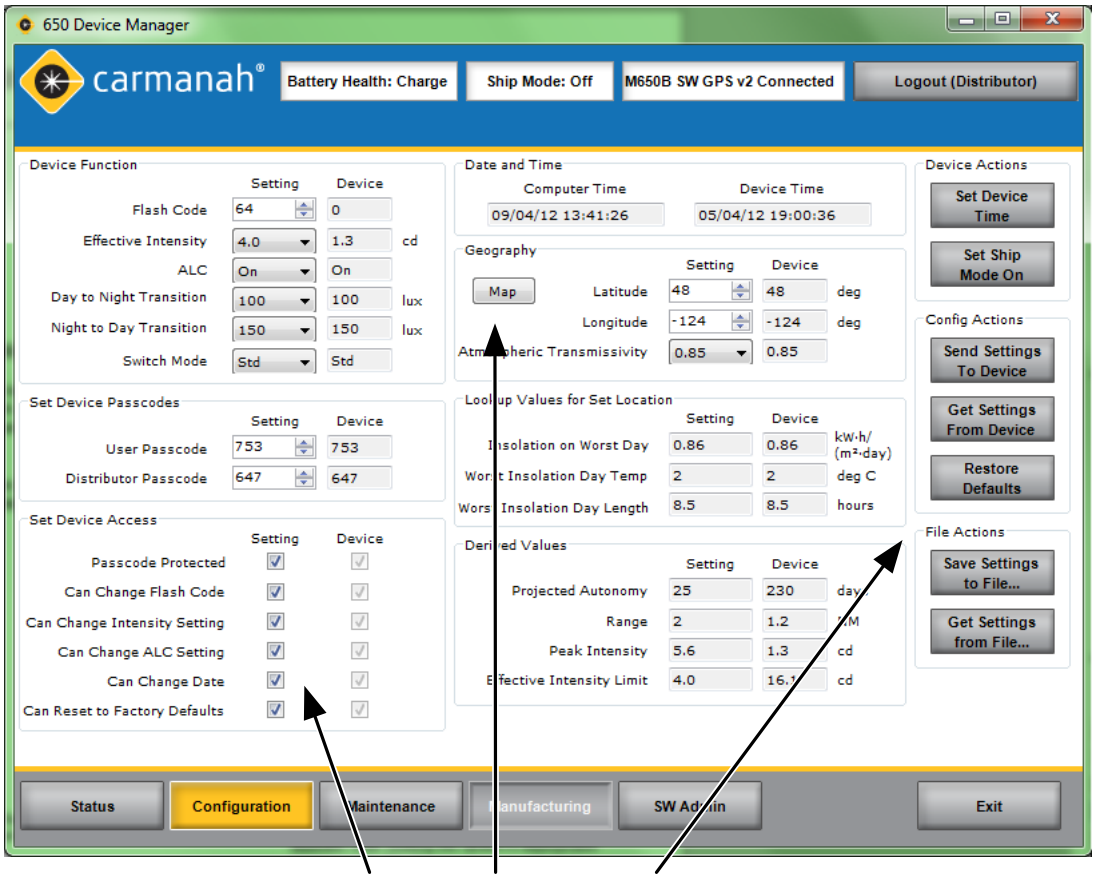

The *Set Device Access*, *Geography*, and *File Actions* areas are available to a Distributor, but not a User. The *Distributor Passcode* field also becomes editable.

Configuring the M650 GPS

The Distributor uses the same procedures as a User to configure an M650 GPS lantern. Refer to User section for details on how to configure the lantern's basic settings.

The following procedures describe the configuration options that are not available to someone with a User Access Level.

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Entering the Deployment Location

As a Distributor, when you configure a customer's lantern, part of the information required is the Deployment Location (where the lantern will actually be located). This location is expressed in Latitude and Longitude.

Knowing the Deployment Location allows the 650DM to convey to the lantern how much solar exposure (insolation) it can expect to receive, the lowest average winter temperature for that location, and the shortest length of day at that location. All of these factors play a part in how much energy the lantern's Battery Pack can expect to receive to power the lantern in a reliable manner.

To enter the Deployment Location:

1. Remove the lantern's Bottom Cover and plug the USB cable into the USB port.

2. Connect the other end of the USB cable to an empty USB port on your computer.

3. Open 650DM on your computer. 650DM may take a moment to find and connect to the lantern

4. Click **Configuration** on the Bottom Bar. The *Configuration* screen appears.

5. In the *Geography* area, enter the latitude and longitude where the lantern will be deployed.

   Alternatively, you can click **Map** and then select the deployment location on the world map that appears. After clicking the lantern's deployment location, click OK. The location you selected appears in the *Latitude* and *Longitude* fields.

6. To set the *Atmospheric Transmissivity (AT)*, click the **down arrow** and select the appropriate value.

   NOTE AT is a measure of how well light transmits through the atmosphere. The AT can be set to 0.85, 0.80, or 0.74. If it is unclear which value to use, use the default value of 0.74..

Setting the User's Device Access

The *Set Device Access* area allows a Distributor to enable or disable a User's ability to edit specific lantern configuration parameters.

The administrator at a customer site typically requests that certain settings are made editable at the User level. For example, if the administrator doesn't require the lanterns to have an access password, or wants to allow a User to change the Flash Code, the Distributor can ensure that the customer's requests are met and become part of the default configuration.

To set a User's Device Access:

1. Remove the lantern's Bottom Cover and plug the USB cable into the USB port.

2. Connect the other end of the USB cable to an empty USB port on your computer.

3. Open 650DM on your computer. 650DM may take a moment to find and connect to the lantern.

4. Click **Configuration** on the Bottom Bar. The *Configuration* screen appears.

5. In the *Set Device Access* area, check the checkboxes to enable the associated features, or clear the checkboxes to disable the features.

6. Click **Save Settings to File…** to save the changes as part of the customer's default configuration, or click **Send Settings to Device** to program a connected lantern with the *Device Access* settings. The checkboxes in the *Device* column indicate the lantern's current configuration.

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Downloading a Configuration

After you finish customizing the lantern's settings (or open a Configuration File), click **Send Setting to Device**. This takes the values that are in the *Setting* columns and sends them to the lantern.

After sending the settings to the lantern, the information in the *Device* columns changes to match the information in the *Setting* columns, indicating that your changes were successful.

Sending a Configuration to a Lantern

You can use two methods to create customized settings and send them to a lantern.

- You can open a Configuration File and send the settings to the lantern.
- You can individually edit the Setting columns prior to sending the settings to the lantern.

The following procedure covers both approaches:

1. Remove the lantern's Bottom Cover and plug the USB cable into the USB port.

2. Connect the other end of the USB cable to an empty USB port on your computer.

3. Open 650DM on your computer. 650DM may take a moment to find and connect to the lantern.

4. Click **Configuration** on the *Bottom Bar*. The *Configuration* screen appears.

5. Manually change the values in the *Setting* columns to the desired values (then skip to step 7)
   -OR-
   Open the desired Configuration File by clicking **Get Settings from File…** (and proceed to the following step)

6. Browse to and **Open** the desired Configuration File. The settings from the Configuration File are entered into the *Setting* columns.

7. Click **Send Settings to Device**. The settings from the *Setting* columns are sent to the lantern, and display in the *Device* columns.

Creating a Configuration File

Different M650 GPS models require different amounts of power to operate at a given configuration (Flash Code, Effective Intensity, etc.). This is due to efficiency differences among LED colours.

Because of this, when you create a Configuration File, you should be connected to a lantern that has the same model number as those that you intend to program with that configuration. This prevents you from specifying a configuration that requires more energy than is available to the lantern.

To create a Configuration File:

1. Remove the lantern's Bottom Cover and plug the USB cable into the USB port.

2. Connect the other end of the USB cable to an empty USB port on your computer.

3. Open 650DM on your computer and login as Distributor. 650DM may take a moment to find and connect to the lantern.

4. Click **Configuration** on the *Bottom Bar*. The *Configuration* page appears.

5. Configure the settings as required to meet the customer's request.

6. In the *File Actions* area on the right side of the page, click **Save Settings to File…**. The *Save As* dialog box appears.

7. Navigate to and save the file to an appropriate location. The file is saved in .DCF format. You can now download this Configuration File to as many lanterns as you would like.

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Reading a Configuration File

If you have several Configuration Files stored on your computer, you can open each file to determine the differences between them.

Each Configuration File contains settings for the following parameters: Flash Code, Effective Intensity, Automatic Light Control, D2N Transition, N2D Transition, Switch Mode, User/Distributor Passcodes, Latitude, Longitude, Transmissivity, and the Device Access settings.

To read a Configuration File:

1. Open 650DM on your computer and login as **Distributor**. 650DM may take a moment to find and connect to the lantern.
2. Click **Configuration** on the Bottom Bar. The *Configuration* page appears.
3. From the *File Actions* area, click **Get Settings from File…**. The *Open* dialog box appears.
4. Navigate to the Configuration File you want to view, and click **Open**. The file's configuration settings appear in the *Settings boxes* on the *Configuration Page*.
5. Repeat this procedure with each Configuration File you want to view.

NOTE Even though the configuration information appears on screen, it is not automatically downloaded to the lantern. To download the configuration to a lantern, you must first connect to the lantern onto which you want to load the settings, then click **Get Settings from File** to open the desired configuration, and then click **Send Settings To Device**.

The order in which you do this is important; if you open the Configuration File and then connect to a lantern, the lantern's values overwrite the settings in the *Settings boxes*. You must connect to the lantern, and then open the Configuration File.

Retrieving a Lantern's Configuration

If you have a lantern that you know is configured correctly, and you would like to copy this configuration over to other lanterns, you have to retrieve the lantern's configuration and save it to your computer (as a DCF file).

To retrieve a device's configuration:

1. Remove the lantern's Bottom Cover and plug the USB cable into the USB port.
2. Connect the other end of the USB cable to an empty USB port on your computer.
3. Open 650DM on your computer. 650DM may take a moment to find and connect to the lantern. The lantern's settings will be copied to the *Settings boxes*.
4. Click **Configuration** on the Bottom Bar. The *Configuration* screen appears.
5. In the *File Actions* area, click **Save Settings to File…**. The *Save As* dialog box appears.
6. Navigate to and save the file to an appropriate location. The file is saved in .DCF format. You can now download this Configuration File to as many lanterns as required.

NOTE If an M650 GPS is already connected to the 650DM, and you want to retrieve the lantern's settings, click the **Get Settings From Device** Button. The lantern's settings will be copied into the *Settings boxes*.

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Saving a Configuration File

If you configure one lantern exactly how you want it, and would like to copy this configuration over to other lanterns, you can save the original lantern's Configuration File, and then copy the file over to the other lanterns. You can also save a lantern's Configuration File just so you have a record of how the lantern is configured.

The Configuration File contains all the values for Flash Code, Effective Intensity, Automatic Light Control, D2N Transition, N2D Transition, Switch Mode, User/Distributor Passcodes, Latitude, Longitude, Transmissivity, and the Device Access settings.

To save a Configuration File:

1. Remove the lantern's Bottom Cover and plug in the USB cable to the USB port.
2. Connect the other end of the USB cable to an empty USB port on your computer.
3. Open 650DM on your computer. 650DM may take a moment to find and connect to the lantern. The lantern's settings will be copied to the *Settings boxes*.
4. Click **Configuration** on the Bottom Bar. The *Configuration* screen appears.
5. In the *File Actions* area, click **Save Settings to File…**. The *Save As* dialog box appears.
6. Navigate to and save the file to an appropriate location. The file is saved in .DCF format. You can now download this Configuration File to as many lanterns as you would like.

NOTE If an M650 GPS is already connected to the 650DM, and you want to save the lantern's settings, click **Get Settings From Device** prior to step 5 above.

Changing Passcodes

Passcode Protected means that a User must enter a Passcode on the OBUI before they can edit any settings.

If the Passcode Protected Setting box is clear (and then this setting is sent to the lantern), the editable settings can be changed without the User having to enter a Passcode on the lantern.

To remove the Passcode requirement:

1. Open 650DM on your computer and login as **Distributor**. 650DM may take a moment to find and connect to the lantern.
2. Click **Configuration** on the *Bottom Bar*. The *Configuration* page appears.
3. In the *Set Device Access* area, clear the **Passcode Protected** Setting box.
4. Click **Send Settings To Device**. Any User can now edit the lantern's configuration using the OBUI, without having to enter a Passcode.

If a customer requests a specific Passcode, then as a Distributor you can assign a Passcode to the User.

To assign a specific Passcode to a customer

1. Open 650DM on your computer and login as **Distributor**. 650DM may take a moment to find and connect to the lantern.
2. Click **Configuration** on the *Bottom Bar*. The *Configuration* page appears.
3. In the *Set Device Passcode* area, type the requested Passcode in the *User Passcode* field.
4. Click **Send Settings To Device**. The updated settings are sent to the lantern. The next time someone tries to access the lantern, they will need to know the new Passcode.

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Updating the Firmware

Occasionally it may be useful to be able to update new firmware to an M650 GPS lantern. These files, when necessary, will be supplied by Carmanah Technologies.

NOTE

If you receive specific firmware upgrade installation instructions from Carmanah Technologies with the firmware file, use those instructions instead of the ones below.

To update the firmware on a lantern:

1. Put the supplied Firmware file (.hex extension) in a suitable location on your hard drive.

2. Remove the lantern's Bottom Cover and plug the USB cable into the USB port.

3. Connect the other end of the USB cable to an empty USB port on your computer.

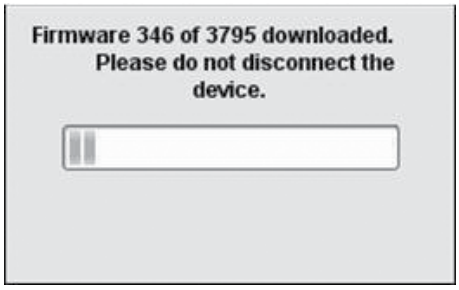
4. Open 650DM on your computer. 650DM may take a moment to find and connect to the lantern.

5. Click **Maintenance** on the Bottom Bar. The *Maintenance* page appears.

6. Save the current lantern's configuration, if you plan to use it after upgrading the firmware. The lantern's configuration settings may be lost in the firmware upgrade process.

7. In the *Firmware* and *Flash Code Table* area, click **Update Firmware**. The *Open* dialog box appears

8. Navigate to and select the **.hex** file you saved to your hard drive, and double-click on the file or click **Open**. The following screen appears:



Do not disconnect the lantern while the firmware is downloading to the lantern. When the file completes downloading, the following screen appears:

9. Click **OK**. The lantern firmware has been updated.

Click **Status** in the *Bottom Bar*, and on the *Status* page, look in the *Firmware* and *Flash Code Table Version* area to confirm the firmware version you are running on your lantern.

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Updating the Flash Code Table

Occasionally it may be useful to load a specific flash code table onto an M650 GPS lantern. These files, when necessary, will be supplied by Carmanah Technologies.

To update the Flash Code Table on a lantern:

1. Put the supplied Flash Code Table file (.csv extension) in a suitable location on your hard drive.

2. Remove the lantern's Bottom Cover and plug the USB cable into the USB port.

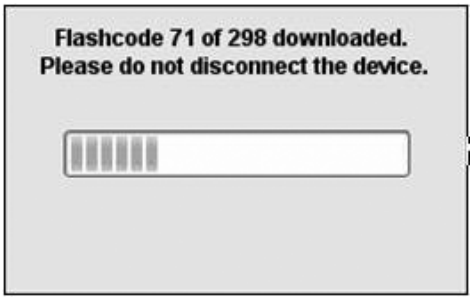
3. Connect the other end of the USB cable to an empty USB port on your computer.

4. Open 650DM on your computer. 650DM may take a moment to find and connect to the lantern.

5. Click **Maintenance** on the *Bottom Bar*. The *Maintenance* page appears.

6. In the *Firmware* and *Flash Code Table* area, click **Update Flash Code Table**. The *Open* dialog box appears

7. Navigate to and select the **.csv** file you saved to your hard drive. The following screen appears:



Do not disconnect the lantern while the Flash Code Table is downloading to the lantern. When the file completes downloading, the following screen appears:

8. Click **OK**. The Flash Code Table has been updated.

Click **Status** in the *Bottom Bar*, and on the **Status** page, look in the *Firmware* and *Flash Code Table Version* area to confirm the version you are running on your lantern.

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Retrieving a Datalog

If you are experiencing technical difficulties with your lantern, Carmanah's Helpdesk may ask you to send them a Datalog from the lantern that they can use for diagnostic purposes.

To obtain a Datalog from a lantern:

1. Remove the lantern's Bottom Cover and plug in the USB cable to the USB port.

2. Connect the other end of the mini-USB cable to an empty USB port on your computer.

3. Open 650DM on your computer.

4. Click **Maintenance** on the *Bottom Bar*. The *Maintenance* page appears.

5. In the *Datalogs* area, click **Get Datalog From Device**. The *Browse For Folder* dialog box appears.

6. Navigate to and select the folder into which you want to save the Datalog (for example, your Windows Desktop).

7. Click **OK**. The Datalog file is saved in the specified location. You can now email this Datalog to Carmanah's Helpdesk to diagnose the problem with the lantern.

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Appendix B: Using the Infrared Remote Programmer

The (optional) Infrared Remote Programmer (IR Remote) allows you to access a subset of the M650 GPS functions. This is useful if the lantern is bolted down, preventing access to the On-Board User Interface (OBUI) or the USB connector.

NOTE The IR Remote uses the following codes:
User Passcode = 753
Off = 000
Ship Mode = 820
Out of Ship Mode = 821
Batt Check = 810

NOTE The IR Passcodes (User and Distributor) are the same ones used to login using the OBUI. They can be changed using the 650 Device Manager software.

NOTE If the "Can Change Flash Code" checkbox is cleared in the 650DM, the Flash Code will not be editable when logged in to the M650 GPS using the User passcode. (The Flash Code can always be edited by logging in with the Distributor Passcode.)

NOTE If the M650 GPS is a switched model, it won't respond to IR commands unless the switch is in the On position.

You can perform the following functions with the IR Remote:

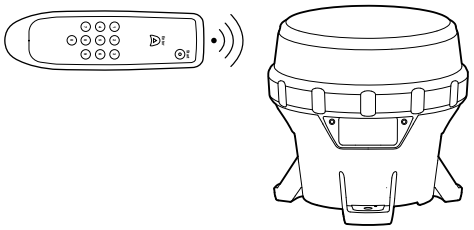
- Check the Battery Pack Health
- Change the Flash Code
- Put the M650 GPS into **Ship Mode**
- Retrieve the M650 GPS from **Ship Mode**
- Enter **Off Mode**

Entering the Passcode

You must enter a Passcode before you can access any of the IR Remote features.

To enter the Passcode:

1. Point the IR Remote at the side of the M650 GPS.



2. Press and hold any button for approximately three seconds. The right-most decimal point on the OBUI illuminates steadily to indicate it received the IR signal and entered IR Edit Mode. In IR Edit Mode, the main LED inside the lens will flash in response to every button press or the IR remote.

3. Press the **Start** button on the IR Remote. The OBUI displays "**I r Pr**" briefly to indicate that it has received the IR signal.

4. Enter the Passcode using the IR Remote. The default Passcode is **753**. Each time you enter one of the digits for the Passcode, the OBUI flashes "Ir X" (where X indicates the button you pressed on the IR Remote. For example, if you press the up button on the IR Remote, the display reads "I r U P"; "I r 0 9" displays when you press the 9 button; etc.).

5. Press the **Enter** button on the IR Remote.

6. After you successfully enter the Passcode, if the main LED was on, it extinguishes and then flashes three times quickly to indicate that the Passcode entry was successful. If the Passcodeentry was unsuccessful, the main LED stays lit. This is a security feature to prevent unauthorized persons from interrupting the main LED during operation. Repeat this procedure to enter the Passcode.

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NOTE

While you are logged in, the main LED flashes whenever it receives a valid IR transmission.

During the login process, the main LED does NOT flash in response to IR remote button presses

After you successfully login, the OBUI scrolls through a Status Report twice. If the M650 GPS is not bolted down, you can view the Status Report on the OBUI through the transparent window in the Bottom Cover.

NOTE

IR Timeout
After you enter the Passcode, if the M650 GPS does not detect any IR
activity, the IR Interface times out after one minute. If this occurs, press and hold any button on the IR Remote for three seconds, and repeat the Passcode entry process.

NOTE

When using the IR Remote, you must always login using a valid Passcode, even if the Passcode Protected flag is cleared using the 650DM. This is a security feature.

NOTE

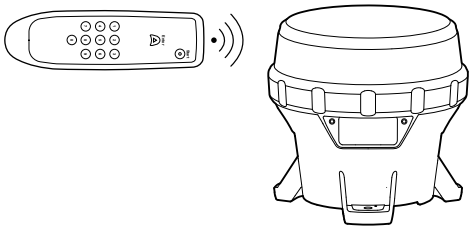
If you enter an incorrect Passcode, the OBUI briefly displays the word "**Fail**". This may indicate that someone has changed the Passcode using the M650 GPS Device Manager.

Changing the Flash Code

The Flash Code you select determines the M650 GPS's flashing pattern. Refer to Appendix F for a complete list of the available Flash Codes.

To change the existing Flash Code:

1. After entering the Passcode, point the IR Remote at the side of the M650 GPS lens and then press the **Start** button on the IR Remote.



2. Enter the new Flash Code by pressing the **three digits** of the new Flash Code on the IR Remote. The main LED flashes once each time the M650 GPS receives a valid keypress.

3. Press **Enter** on the IR Remote. If the new Flash Code update was successful, the main LED flashes three times quickly, and then the M650 GPS runs through the new Flash sequence for one minute (or until another IR transmission is received from the IR Remote). If the new Flash Code update was unsuccessful, the main LED flashes twice slowly.

NOTE

If the main LED responds with two slow flashes after you enter the new Flash Code, then the Flash Code is not valid, or it consumes more than the available energy at the programmed intensity.

Using the OBUI, changing the Flash Code can force the intensity to change, but that does not occur when changing the flash via infrared. This, and the inability of the IR to trigger a status report without first entering a valid Passcode, are two key differences between the OBUI and IR interface.

Either select a different Flash Code, or reduce the effective intensity setting using the OBUI or M650 GPS Device Manager software.

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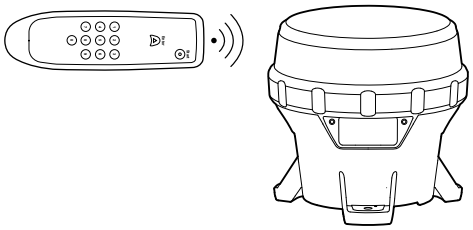
Turning the M650 GPS Off

To turn the M650 GPS off using the IR Remote, you must set the Flash Code to 000. To do this:

1. After entering the Passcode, point the IR Remote at the side of the M650 GPS lens and press the **Start** button on the IR Remote.



2. Enter the Flash Code "**000**" using the IR Remote. The main LED flashes once each time the M650 GPS receives a keypress.

3. Press the **Enter** button on the IR Remote. If the Flash Code update was successful, the main LED flashes three times quickly. If the Flash Code update was unsuccessful, the main LED flashes twice slowly. If you were unsuccessful, it means the Flash Code was entered incorrectly. Repeat this process using the Flash Code "**000**".

NOTE When the M650 GPS is in **Off** mode, the main LED does not illuminate. However, it continues to charge when exposed to sufficiently intense light.

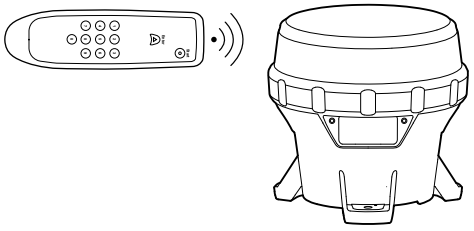
NOTE If you set the M650 GPS to **Off** mode using the OBUI, the M650 GPS will still respond to infrared commands.

Setting the M650 GPS to Ship Mode

If you are storing an M650 GPS, or have to return it to your distributor for maintenance or repair, it is best to put the M650 GPS into **Ship Mode** or **Off** mode. When the M650 GPS exits **Ship Mode** and returns to normal operation, it will remember its Flash Code, intensity and other settings.

To set the M650 GPS to **Ship Mode**:

1. After entering the Passcode, point the IR Remote at the side of the M650 GPS lens and then press the **Start** button on the IR Remote.



2. Enter **820** using the IR Remote. The main LED flashes once each time the M650 GPS receives a valid keypress.

3. Press the **Enter** button on the IR Remote. If the **Ship Mode** command was successful, the main LED flashes three times quickly. The M650 GPS is now in **Ship Mode**. If the command was unsuccessful, the main LED flashes twice slowly. If you were unsuccessful, repeat the process: **Start**, **820**, **Enter**.

After you enter **Ship Mode**, place the M650 GPS into the box in which it is being stored or shipped, and close the lid. The main LED remains off until the device is removed from the box and senses a day-to-night transition. It then continues to operate in dusk-to-dawn mode. Please follow the storage recommendations outlined on pg. 23.

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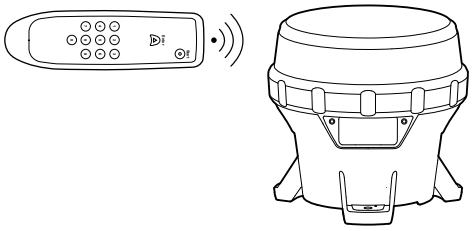
Restoring the M650 GPS from Ship Mode

The M650 GPS automatically exits **Ship Mode** when it detects a day-to-night transition. However, to exit **Ship Mode** manually use the following procedure:

1. After entering the Passcode, point the IR Remote at the side of the M650 GPS lens and then press the IR Remote **Start** button.



2. Enter **821** using the IR Remote. The main LED flashes once each time the M650 GPS receives a keypress.

3. Press the **Enter** button on the IR Remote. If the command was successful, the main LED flashes three times quickly. The M650 GPS is now out of Ship Mode. If the command was unsuccessful, the main LED flashes twice slowly. If you were unsuccessful, repeat this process (Start, **821**, Enter).

4. After you take the M650 GPS out of Ship Mode, determine the Battery Pack's State of Health using either the OBUI or the IR Remote. If the Battery Pack is not in good health, either charge or replace the Battery Pack (see pg 21, 23).

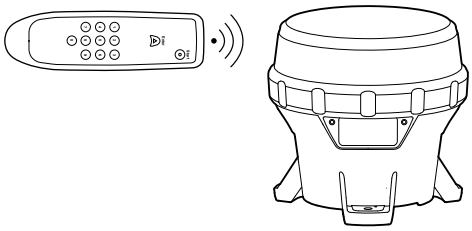
If you successfully remove the M650 GPS from **Ship Mode**, the M650 GPS begins to operate automatically in dusk-to-dawn mode.

NOTE Check the M650 GPS's Flash Code before deploying it. If the Flash Code is set to **000**, it indicates that the M650 GPS is in **Off** mode, and the main LED will not turn on even with the arrival of dusk.

Determining the Battery Pack's State of Health

You can use the IR Remote to check the M650 GPS's Battery Pack's state of health.

1. After entering the Passcode, point the IR Remote at the side of the M650 GPS lens and then press the **Start** button on the IR Remote. The main LED flashes once.



2. Enter **810** using the IR Remote. The main LED flashes once each time the M650 GPS receives a signal.

3. Press **Start** on the IR Remote. The main LED flashes once, and if the command entry was successful, the main LED will flash three times quickly, and then display the Battery Pack's state of health using a series of flashes from the main LED. Use the following table to determine the Battery Pack's state of health.

Number of Flashes	State of Health
4	Bad
7	Charge
10	Good

If the Battery Pack Health Status Request was unsuccessful, the main LED flashes twice slowly. If you were unsuccessful, repeat this process (**Start, 810, Enter**).

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Appendix C: Ordering Codes

The following sections lists the M650 GPS ordering codes and the accessories available from your Carmanah Distributor:

Ordering Code Format:

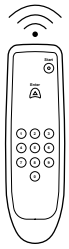
M650X-020X

M - Marine	B - Blue	0 - Without switch
	G - Green	1 - With switch
	R - Red	
	Y - Yellow	
	W - White	

For example, M650R-0201 is a red, switched marine M650 with GPS.

M650 GPS Accessories

Infrared Remote Programmer
Part# 56818



M650 GPS lanterns are user-programmable using an optional infrared programmer. Functions available through the programmer include:

- Flash code settings
- Intensity and autonomy adjustments
- LUX level adjustments for the photosensor that automatically turns them on/off at dusk/dawn
- Activation / deactivation ability for storage or transport
- A Battery Pack Health check to determine the relative health of the battery pack.

M650 GPS Standard Bolt Kit
Part# 38334

The M650 GPS Standard Bolt Kit contains the required hardware to mount M650 GPS lanterns to the correct mounting bases. Each package contains the necessary items to properly mount one lantern. Part list includes:

- Nut, lock, ¼”-20, SS (3)
- Washer, flat, ¼”, SS (9)
- ¼”-20 x 1½”, hex cap screw, SS (3)

M650 GPS Security Mounting Bolt Kit (Includes Drivers)
Part# 38335

The Security Bolt Kit with drivers contains the required hardware to mount M650 GPS lanterns to the mounting plate, when added security is a consideration. Ideal for single unit installations, each package contains the necessary items to properly mount one lantern. Part list includes:

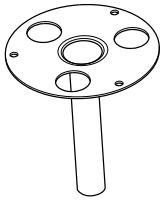
- Nut, security, ¼”-20, trident (3)
- Driver for trident ¼”-20 nut (1)
- Driver, hex security bit, 876-770 Spaenaur (1)
- Washer, flat, ¼”, SS (9)
- Screw, security, button head, ¼”-20 x 1.5”, SS (3)

M650 GPS Security Bolt Kit (Excludes Drivers)
Part# 56578

The M650 GPS Security Bolt Kit without drivers is ideal for multiple unit installations that only require a single driver. Additional drivers can be purchased as required. Part list includes:

- ¼”-20 x 1 ½ BH Keyed-Lok M/S SS (3)
- Nut - Penta, ¼”-20 SS 316 Security (3)

M650 GPS Mounting Plate
Part# 51925



The Carmanah M650 GPS mounting plate is designed for elevated lighting. Applications include: security barriers, aquaculture farms or other difficult to mount places.

M650 GPS Replacement Battery Pack
Part # 57383

A replacement Battery Pack is available for the M650 GPS. The Battery Pack is ready for installation in the M650 GPS and does not require tools or other parts.

Bird Deterrent
Part# 57003

The Bird Deterrent is designed to work with the M650 GPS lantern. Each kit contains one bird deterrent that attaches to one of the M650 GPS's mounting feet. Up to three bird deterrents can be attached to an M650 GPS.

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Appendix D: Specifications

Form-Factor

Mounting: 5.9 inch (150 mm), 3-hole
Mounting Orientation: N/A; symmetrical
Over-torque resistant: Yes
Chassis Materials: polycarbonate / polysiloxane alloy
Height: 6.7 inch (169 mm)
Width: 6.9 inch (176 mm)
Weight: 3.5 lb (1.58 kg)
Operating Temp.: -45 to 124 ºF (-43 to 51 ºC)
Storage Temp.: -45 to 176 ºF (-43 to 80 ºC)

Optical

Light Source: High-power LED
Intensity (as per IALA rating): 44 cd (Green LEDs)
Chromaticity: IALA Optimum, SAE (December 2008)
Flash Settings: 256+ Flash Codes
Ambient Light Sensing: 25 - 925 lux
LED Corrections: Yes - temperature, colour, flash code, efficacy, voltage
Automatic Light Control (ALC): Yes
Visual Colour Indicator: Yes, Green, Red, Yellow, Blue or White
Vertical Divergence: > 8° (FWHM)

Energy Capture

Solar Panel Power: High-efficiency cells
Air Gap between Solar Panel and Lens: No
Maximum Power Point Tracking (MPPT): Yes
Float Charge Cut-off: Yes
Battery Charger: Temperature-compensated, constant-voltage
Reverse Polarity Protection: Yes
Solar Panel Bypass Diodes: Yes
Solar Panel Blocking Diode Function: Yes

Flash Synchronization

GPS: Internal GPS Receiver with rapid signal lock

Energy Storage

Replaceable Battery Pack: Yes (tool-less)
Secured Battery Pack: Yes. Strap material meets ASTM D2000 2BG613-F7-G21
Vented Battery Pack Compartment: Yes
Battery Status Feedback: Good, Charge, Bad (Replace)

User Interface

User Interface: Onboard LED Display; External Switch option; IR option; USB connection to PC
Datalogger: Yes
Self-Test: Yes
Battery Pack State of Health: Yes
External Switch: Optional
Ability to Connect to Computer: Yes - USB
Wireless Control: IR only

Standards and Testing

UL/cUL: Pending
RoHS: Yes
EMC and EMI: to be approved for EU/CE, USA, CAN, AU, others
Vibration: 10g, 10 - 60 Hz
Shock, Pulse: Tested to MIL-STD-202G, Method 213B, Test Condition G, 50 – 75g
Shock, Handling: 48 inch (122 cm) drop onto solid wood on concrete
Hail: Tested to EN 61215, 1 inch (25 mm) OD up to 50mph (23 m/s)
Wind Loading: 140 knots (72m/s)
Immersion: IP68, MIL-STD-202G, Method 104A, Test Condition B
Salt Spray: Tested to MIL_STD-810G, ASTM B117-73(1979)
ESD: Tested to EN 61000-6-2:2001, +/-8 to +/-25 kV Discharge
Chemical Resistance: Tested to MIL-STD-810G, Method 504, Procedure II

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Standards and Testing (continued)

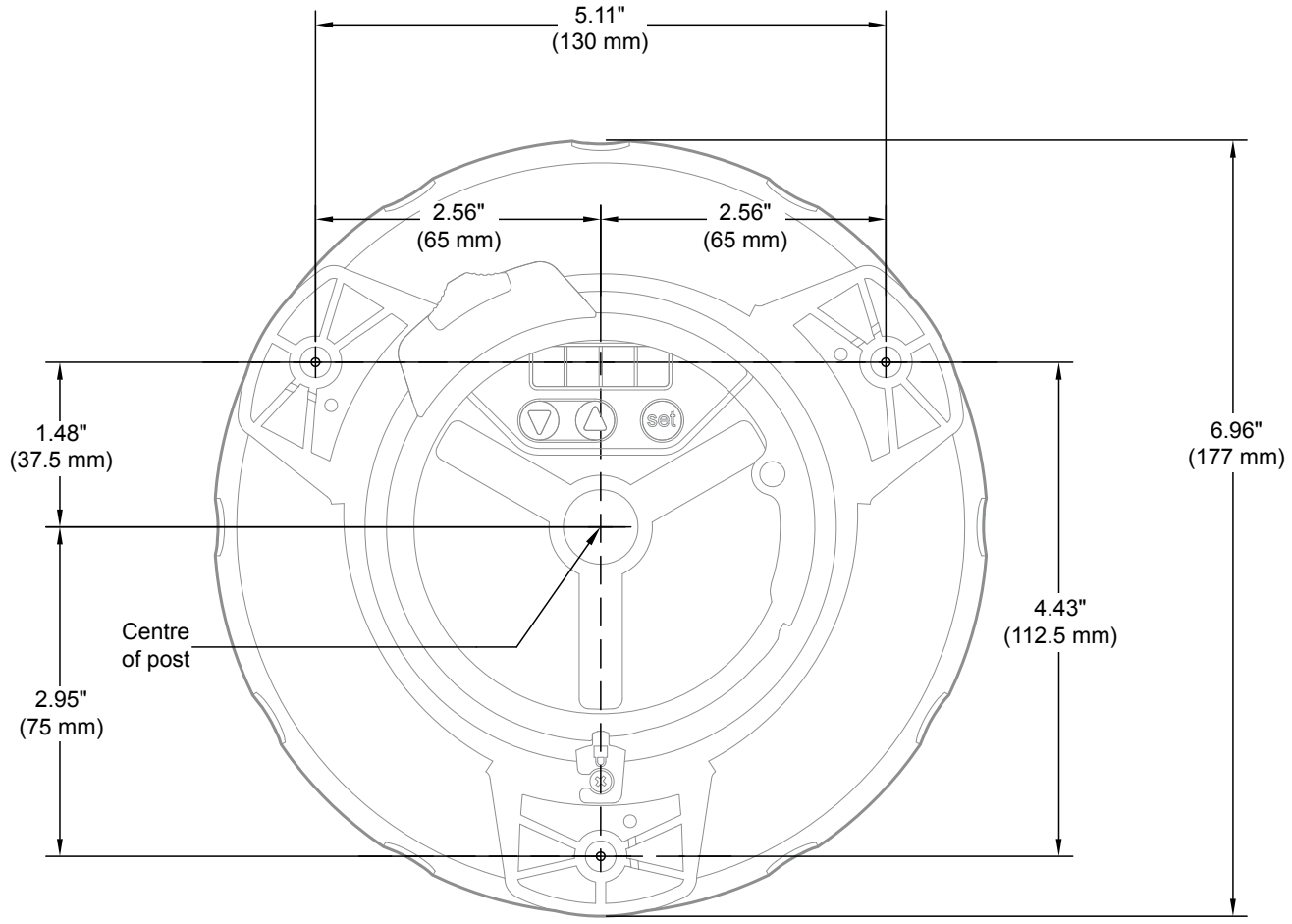
Vandalism: Tested to withstand hits from a 27 inch (69 cm) bat
Pressure Washer: Tested to withstand up to 2900 psi (20 MPa)
Mounting Over-torque: Tested to withstand up to 65 ft-lb (88 N-m)
Humidity/Damp Heat: Tested to MIL-STD-810G, Method 507.5
UV Exposure: Tested to MIL-STD-810G, Method 505.5, Procedure II, 1120 W/m2, 44°C
RF/EMI Resilience: Tested to EN 60945:2002, EN 61000-4-3:1995, 100MHz -1GHz, 10V/m and 1GHz -12GHz, 200V/m
Battery Life: Tested equivalent to IEC 61427

Patents

US 6,573,659 and other US, Canadian, EU patents pending

Mounting

Mounting bolt size: 0.25 inch (6mm or 7mm)
Mounting foot thickness: 0.5 inch (12.7mm)
Mounting bolt torque (minimum: 4 lbf·ft (5.4 N·m)
Mount post diameter (minimum): 7 inch (177mm)
Bolt circle diameter: 5.91 inch (150mm)



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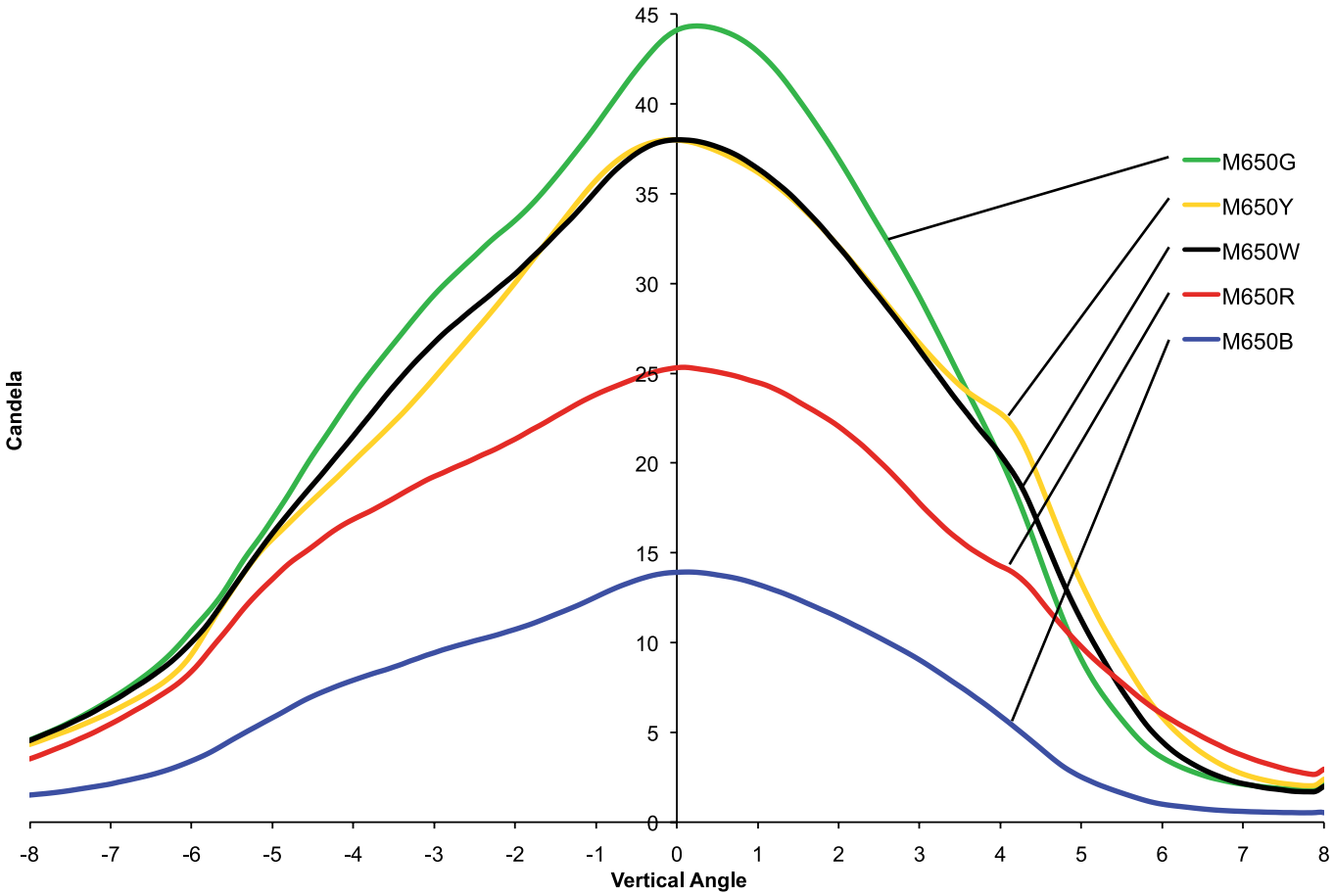
Photometric Plots



NOTE Peak IALA intensity dependant on location. Plot based on equatorial location of 12-hour night duration and 21% duty cycle flash code.

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Appendix E: Flash Codes

Flash Code	Flash Character	Fl1	EC1	Fl2	EC2	Fl3	EC3	Fl4	EC4	Fl5	EC5	Fl6	EC6	Fl7	EC7	Fl8	EC8	Fl9	EC9
1	F	60	0																
2	Fl(2) 10s	0.5	1	0.5	8														
3	Fl(2) 10s	0.5	1.5	0.5	7.5														
4	Fl(2) 10s	0.8	1.2	0.8	7.2														
5	Fl(2) 10s	1	1	1	7														
6	Fl(2) 10s	1	1.5	1	6.5														
7	Fl(2) 12s	0.5	1	0.5	10														
8	Fl(2) 12s	1.5	2	1.5	7														
9	Fl(2) 15s	1	2	1	11														
10	Fl(2) 5s	0.5	1	0.5	3														
11	Fl(2) 5s	1	1	1	2														
12	Fl(2) 6s	0.5	1	0.5	4														
13	Fl(2) 6s	0.8	1.2	0.8	3.2														
14	Fl(2) 6s	1	1	1	3														
15	Fl(2) 7s	1	1	1	4														
16	Fl(2) 8s	0.5	1	0.5	6														
17	Fl(2) 8s	1	1	1	5														
18	Fl(2+1) 10s	0.5	0.7	0.5	2.1	0.5	5.7												
19	Fl(2+1) 12s	0.8	1.2	0.8	2.4	0.8	6												
20	Fl(2+1) 12s	1	1	1	4	1	4												
21	Fl(2+1) 15s	1	2	1	5	1	5												
22	Fl(2+1) 6s	0.3	0.4	0.3	1.2	0.3	3.5												
23	Fl(3) 12S	0.5	2	0.5	2	0.5	6.5												
24	Fl(3) 10s	0.5	1.5	0.5	1.5	0.5	5.5												
25	Fl(3) 10s	1	1	1	1	1	5												
26	Fl(3) 12s	0.8	1.2	0.8	1.2	0.8	7.2												
27	Fl(3) 15s	0.3	1.7	0.3	1.7	0.3	10.7												
28	Fl(3) 15s	0.5	1.5	0.5	1.5	0.5	10.5												
29	Fl(3) 20s	0.5	3	0.5	3	0.5	12.5												

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Flash Code	Flash Character	FI1	EC1	FI2	EC2	FI3	EC3	FI4	EC4	FI5	EC5	FI6	EC6	FI7	EC7	FI8	EC8	FI9	EC9
30	FI(3) 9s	0.8	1.2	0.8	1.2	0.8	4.2												
31	FI(4) 10s	0.5	1	0.5	1	0.5	1	0.5	5										
32	FI(4) 10s	0.8	1.2	0.8	1.2	0.8	1.2	0.8	3.2										
33	FI(4) 12s	0.8	1.2	0.8	1.2	0.8	1.2	0.8	5.2										
34	FI(4) 15s	0.5	1.5	0.5	1.5	0.5	1.5	0.5	8.5										
35	FI(4) 15s	1	1	1	1	1	1	1	8										
36	FI(4) 20s	0.5	1.5	0.5	1.5	0.5	1.5	0.5	13.5										
37	FI(5) 20s	0.8	1.2	0.8	1.2	0.8	1.2	0.8	1.2	0.8	11.2								
38	FI(5) 20s	1	1	1	1	1	1	1	1	1	11								
39	FI(6) 15s	0.5	1	0.5	1	0.5	1	0.5	1	0.5	1	0.5	7						
40	FL-*	5	1	1	1														
41	FL-**	5	1	1	1	1	1												
42	FI 1.5s	0.3	1.2																
43	FI 1.5s	0.5	1																
44	FI 10s	0.5	9.5																
45	FI 10s	1	9																
46	FI 10s	1.5	8.5																
47	FI 12s	1.2	10.8																
48	FI 15s	1	14																
49	FI 2.5s	0.3	2.2																
50	FI 2.5s	0.5	2																
51	FI 2.8s	0.3	2.5																
52	FI 2s	0.2	1.8																
53	FI 2s	0.3	1.7																
54	FI 2s	0.4	1.6																
55	FI 2s	0.5	1.5																
56	FI 2s	0.7	1.3																
57	FI 2s	0.8	1.2																
58	FI 3s	0.3	2.7																
59	FI 3s	0.5	2.5																

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Flash Code	Flash Character	FI1	EC1	FI2	EC2	FI3	EC3	FI4	EC4	FI5	EC5	FI6	EC6	FI7	EC7	FI8	EC8	FI9	EC9
60	Fl 3s	0.7	2.3																
61	Fl 3s	1	2																
62	Fl 4.3s	1.3	3																
63	Fl 4.4s	0.4	4																
64	Fl 4s	0.5	3.5																
65	Fl 4s	0.8	3.2																
66	Fl 4s	1	3																
67	Fl 4s	1.5	2.5																
68	Fl 5s	0.3	4.7																
69	Fl 5s	0.5	4.5																
70	Fl 5s	1	4																
71	Fl 5s	1.5	4.5																
72	Fl 6s	0.5	5.5																
73	Fl 6s	0.6	5.4																
74	Fl 6s	1	5																
75	Fl 6s	1.5	3.5																
76	Fl 7.5s	0.8	6.7																
77	ISO 10S	5	5																
78	ISO 2S	1	1																
79	ISO 4S	2	2																
80	ISO 5S	2.5	2.5																
81	ISO 6S	3	3																
82	ISO 8S	4	4																
83	ISO 3S	1.5	1.5																
84	LFL 10S	2	8																
85	LFL 10S	3	7																
86	LFL 10S	4	6																
87	LFL 12S	2	10																
88	LFL 15S	4	11																
89	LFL 5S	2	3																

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Flash Code	Flash Character	FI1	EC1	FI2	EC2	FI3	EC3	FI4	EC4	FI5	EC5	FI6	EC6	FI7	EC7	FI8	EC8	FI9	EC9
90	LFL 6S	2	4																
91	LFL 8S	2	6																
92	LFL 8S	3	5																
93	MO(A) 10S	0.5	0.5	1.5	7.5														
94	MO(A) 15s	0.5	1.5	2	11														
95	MO(A) 6s	0.3	0.6	1	4.1														
96	MO(A) 8s	0.8	1.2	2.4	3.6														
97	MO(B) 15S	1.5	0.5	0.5	0.5	0.5	0.5	0.5	10.5										
98	MO(U) 10S	0.3	0.7	0.3	0.7	0.9	7.1												
99	MO(U) 10S	0.4	0.6	0.4	0.6	1.2	6.8												
100	MO(U) 10S	0.5	0.5	0.5	0.5	1.5	6.5												
101	MO(U) 15S	0.5	0.5	0.5	0.5	1.5	11.5												
102	MO(U) 15S	0.6	0.3	0.6	0.3	1.4	11.8												
103	MO(U) 15S	0.7	0.5	0.7	0.5	1.9	10.7												
104	MO(U) 15S	0.7	0.7	0.7	0.7	2.1	10.1												
105	MO(U) 15S	0.75	0.45	0.75	0.45	2	10.6												
106	MO(U) 15S	1.15	0.73	1.15	0.73	3.03	8.21												
107	MO(U) 15S	1.3	0.7	1.3	0.7	3.3	7.7												
108	MO(U) 15S****	0.75	0.15	0.75	0.15	1.65	11.55												
109	MO(U) 15S*	0.45	0.45	0.45	0.45	1.35	11.85												
110	MO(U) 15S**	0.55	0.35	0.55	0.35	1.45	11.75												
111	MO(U) 15S***	0.6	0.3	0.6	0.3	1.5	11.7												
112	MO(U) 10S	0.2	0.8	0.2	0.8	0.6	7.4												
113	OC 10S	7	3																
114	OC 10S	7.5	2.5																
115	OC 15S	10	5																
116	OC 3S	2	1																
117	OC 3S	2.5	0.5																

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Flash Code	Flash Character	Fl1	EC1	Fl2	EC2	Fl3	EC3	Fl4	EC4	Fl5	EC5	Fl6	EC6	Fl7	EC7	Fl8	EC8	Fl9	EC9
118	OC 4S	3	1																
119	OC 5S	3	2																
120	OC 5S	4	1																
121	OC 5S	4.5	0.5																
122	OC 6S	4	2																
123	OC 6S	4.5	1.5																
124	OC 6S	5	1																
125	Q 1.2S	0.3	0.9																
126	Q 1.2S	0.5	0.7																
127	Q 1.2S	0.6	0.6																
128	Q 1S	0.2	0.8																
129	Q 1S	0.3	0.7																
130	Q 1S	0.4	0.6																
131	Q 1S	0.5	0.5																
132	Q 1S	0.8	0.2																
133	Q(2) 10S	0.5	1.5	0.5	7.5														
134	Q(2) 10S	0.6	0.4	0.6	8.4														
135	Q(2) 5S	0.3	0.7	0.3	3.7														
136	Q(2) 6S	0.3	0.7	0.3	4.7														
137	Q(2) 6S	0.35	0.7	0.35	4.6														
138	Q(3) 10S	0.3	0.7	0.3	0.7	0.3	7.7												
139	Q(3) 10S	0.35	0.65	0.35	0.65	0.35	7.65												
140	Q(3) 10S	0.6	0.6	0.6	0.6	0.6	7												
141	Q(4) 10S	0.3	0.7	0.3	0.7	0.3	0.7	0.3	6.7										
142	Q(4) 12S	0.3	0.7	0.3	0.7	0.3	0.7	0.3	8.7										
143	Q(4) 15S	0.35	0.7	0.35	0.7	0.35	0.7	0.35	11.5										
144	Q(4) 20S	0.5	0.5	0.5	0.5	0.5	0.5	0.5	16.5										
145	Q(4) 6S	0.4	0.6	0.4	0.6	0.4	0.6	0.4	2.6										
146	Q(5) 10S	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.3	5.7								
147	Q(5) 20S	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.3	15.7								

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Flash Code	Flash Character	Fl1	EC1	Fl2	EC2	Fl3	EC3	Fl4	EC4	Fl5	EC5	Fl6	EC6	Fl7	EC7	Fl8	EC8	Fl9	EC9
148	Q(5) 20S	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	15.5								
149	Q(5) 7S	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.3	2.7								
150	Q(6) 10S	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.3	4.7						
151	Q(6)+LFL 15S	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.7	2	7				
152	Q(6)+LFL 15S	0.35	0.65	0.35	0.65	0.35	0.65	0.35	0.65	0.35	0.65	0.35	0.65	1.05	7.95				
153	Q(6)+LFL 15S	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	2	5.8				
154	Q(9) 15S	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.3	6.7
155	Q(9) 15S	0.35	0.65	0.35	0.65	0.35	0.65	0.35	0.65	0.35	0.65	0.35	0.65	0.35	0.65	0.35	0.65	0.35	6.65
156	Q(9) 15S	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	4.8
157	VQ 0.5S	0.15	0.35																
158	VQ 0.5S	0.2	0.3																
159	VQ 0.6S	0.2	0.4																
160	VQ 0.6S	0.3	0.3																
161	VQ(3) 5S	0.15	0.35	0.15	0.35	0.15	3.85												
162	VQ(3) 5S	0.2	0.3	0.2	0.3	0.2	3.8												
163	VQ(3) 5S	0.3	0.3	0.3	0.3	0.3	3.5												
164	VQ(6)+LFL 10S	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3	2	5				
165	VQ(6)+LFL 10S	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2	4.4				
166	VQ(9) 10S	0.15	0.35	0.15	0.35	0.15	0.35	0.15	0.35	0.15	0.35	0.15	0.35	0.15	0.35	0.15	0.35	0.15	5.85
167	VQ(9) 10S	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.2	5.8
168	VQ(9) 10S	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	4.9
169	Q(2) 7S	0.5	1	0.5	5														
170	Fl(2) 5s	0.3	0.4	0.3	4														
171	Fl(2) 10s	0.5	0.7	0.5	8.3														
172	Fl(5) 20s	0.5	1	0.5	1	0.5	1	0.5	1	0.5	13.5								
173	Fl(2) 10s	1	2	1	6														
174	Fl 4s	0.4	3.6																

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Flash Code	Flash Character	Fl1	EC1	Fl2	EC2	Fl3	EC3	Fl4	EC4	Fl5	EC5	Fl6	EC6	Fl7	EC7	Fl8	EC8	Fl9	EC9
175	Fl(2) 5s	0.4	0.6	0.4	3.6														
176	Mo(A) 8s	0.4	0.6	2	5														
177	Fl 2.5s	1	1.5																
178	Fl(3+1) 20 s	0.5	1.5	0.5	1.5	0.5	4.5	0.5	10.5										
179	Fl(3+1) 20 s	0.6	1.4	0.6	1.4	0.6	4.4	0.6	10.4										
180	Fl(3+1) 20 s	0.65	1.35	0.65	1.35	0.65	4.35	0.65	10.35										
181	Fl(3+1) 20 s	0.7	1.3	0.7	1.3	0.7	4.3	0.7	10.3										
182	Fl(3+1) 20 s	0.8	1.2	0.8	1.2	0.8	4.2	0.8	10.2										
183	Fl(2) 7s	0.5	1.5	0.5	4.5														
184	Fl(3) 9s	0.5	1.5	0.5	1.5	0.5	4.5												
185	LFL 11s	2	9																
186	Fl(6+1) 15s	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	7				
187	Mo (0) 12s	1.5	0.5	1.5	0.5	1.5	6.5												
188	Mo (0) 15s	1.5	0.5	1.5	0.5	1.5	9.5												
189	Q 1S	0.25	0.75																
190	Q (3) 4.6s	0.3	0.7	0.3	2	0.3	1												
191	Fl 7.5s	0.5	7																
192	Fl (4) 11s	0.5	1.5	0.5	1.5	0.5	1.5	0.5	4.5										
193	FL (3) 21s	0.5	1.5	0.5	4.5	0.5	13.5												
194	FL (3) 6s	0.5	0.5	0.5	0.5	0.5	3.5												
195	FL(3)10s	0.5	0.5	0.5	0.5	0.5	7.5												
196	FL(9)15s	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	6.5
197	OC(2)6s	3	1	1	1														
198	OC(3)8s	3	1	1	1	1	1												
199	OC(4)10s	3	1	1	1	1	1	1	1										
200	FL(2)6s	0.5	1.5	0.5	3.5														
201	FL(1)8s	0.5	7.5																
202	FL(3)15s	0.3	1.7	0.3	1.7	0.3	10.7												
203	FL(2)5s	0.2	0.8	0.2	3.8														
204	FL(2)4s	0.5	1	0.5	2														

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Flash Code	Flash Character	Fl1	EC1	Fl2	EC2	Fl3	EC3	Fl4	EC4	Fl5	EC5	Fl6	EC6	Fl7	EC7	Fl8	EC8	Fl9	EC9
205	FL(2)4.5s	0.3	1	0.3	2.9														
206	FL(3)10s	0.5	1.5	0.5	1.5	0.5	5.5												
207	FL(3)15s	0.5	1.5	0.5	1.5	0.5	10.5												
208	Mo(B)16s	1.5	0.5	0.5	0.5	1.5	0.5	0.5	10.5										
209	Q 1s	0.15	0.85																
210	Fl(2+1) 10s	0.6	0.6	0.6	1.8	0.6	5.8												
211	MO(U) 15S	0.4	0.5	0.4	0.5	1.2	12												
212	Q 1.2S	0.2	1																
213	Q(3) 10S	0.2	1	0.2	1	0.2	7.4												
214	Q(6)+LFL 15S	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	3	4.8				
215	VQ(3) 5S	0.2	0.4	0.2	0.4	0.2	3.6												
216	VQ(6)+LFL 10S	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	3	3.4				
217	VQ(9) 10S	0.2	0.4	0.2	0.4	0.2	0.4	0.2	0.4	0.2	0.4	0.2	0.4	0.2	0.4	0.2	0.4	0.2	5
218	OC (3) 12S	4.5	1.5	1.5	1.5	1.5	1.5												
219	OC(4) 12S	5	1	1	1	1	1	1	1										
220	FL(3) 12S	1	1.5	1	1.5	1	6												
221	FL(4) 15S	1	1.5	1	1.5	1	1.5	1	6.5										
222	FL(5) 20S	1	1.5	1	1.5	1	1.5	1	1.5	1	9								
223	MO(A)	1	1	3	7														
224	FL(5) 20S SADO	0.5	1.5	0.5	1.5	0.5	1.5	0.5	1.5	0.5	11.5								
225	FL(4) 15S	0.5	2	0.5	2	0.5	2	0.5	7										
226	FL(5) 20S	0.5	2	0.5	2	0.5	2	0.5	2	0.5	9.5								
227	Q(6)+LFL 15S	0.2	1	0.2	1	0.2	1	0.2	1	0.2	1	0.2	1	3	4.8				
228	Q(9) 15S	0.2	1	0.2	1	0.2	1	0.2	1	0.2	1	0.2	1	0.2	1	0.2	1	0.2	5.2
229	VQ(6)+LFL 10S	0.2	0.4	0.2	0.4	0.2	0.4	0.2	0.4	0.2	0.4	0.2	0.4	3	3.4				
230	CST1	3.273	1.091	1.091	1.091	3.273	1.091	1.091	30										
231	CST2	6	15																

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Flash Code	Flash Character	FI1	EC1	FI2	EC2	FI3	EC3	FI4	EC4	FI5	EC5	FI6	EC6	FI7	EC7	FI8	EC8	FI9	EC9
232	LFL 24s	9	15																
233	CST4	3	10																
234	CST5	0.5	1	0.5	1	0.5	4.5												
235	CST6	0.4	0.7	0.4	0.7	0.4	0.7	0.4	0.7	0.4	20.2								
236	CST7	1.5	0.5																
237	CST8	0.5	2.5	0.5	2.5	0.5	2.5	0.5	10.5										
238	CST9	0.6	0.3	0.6	0.3	1.5	56.7												
239	CST10	0.5	1.5	0.5	2.5														
240	CST11	0.3	0.7	0.3	2.7														
241	CST12	6	6																
242	CST13	2	1	5	1														
243	CST14	0.4	0.6	0.4	0.6	0.4	2.6												
244	CST15	0.8	1	0.8	1	0.8	1	0.8	1	0.8	2								
245	CST16	0.8	1	0.8	1	0.8	1	0.8	3.8										
246	CST17	0.5	0.5	0.5	0.5	0.5	5.5												
247	CST18	0.5	2.5	0.5	2.5	0.5	2.5	0.5	10.5										
248	CST19	0.8	5.2																
249	CST20	0.8	6.2																
250	CST21	0.5	2	0.5	2	0.5	2	0.5	8										
251	Fl 3.5s	0.7	2.8																
252	Fl 3.6s	0.7	2.9																
253	Fl 5.5s	0.7	4.8																
254	Fl(3) 15s	0.5	1.5	0.5	3	0.5	9												
255	GpD(5) 14s	0.5	1.5	0.5	1.5	0.5	1.5	0.5	1.5	0.5	5.5								
256	GpD(5) 15s	0.5	1.5	0.5	1.5	0.5	1.5	0.5	1.5	0.5	6.5								
257	ISO 2.5S	1.25	1.25																
258	Fl(3) 10s	0.5	1.5	0.5	0.5	1.5	5.5												
259 -297	SYS: future use	0	0																
298	ENDCODE																		

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Appendix F: Calculation of Nominal Range and Effective Intensity

Nominal Range

The nominal range or effective intensity of a lantern comes from the following calculation known as Allard's Law documented in IALA Recommendations E-122 (2001) and E-200-2 (2008):

$$I_e = \frac{E \times D^2}{0.05^{\frac{D}{V}}}$$

I_e = effective intensity (cd)
E = threshold of detection (lux)
D = nominal range (m)
V = visibility (m)

Threshold of detection is 0.0000002 lux for a lantern at night-time with no background light.

Visibility is a function of atmospheric transmissivity. Typically, transmissivity (T) = 0.74 and V = 18520 m (10 NM). At equatorial latitudes and clear skies, T = 0.85 and V = 34262 m (18.5 NM).

Night Time Range and Intensities

RANGE (NM)	EFFECTIVE INTENSITY (cd)	
	T = 0.74	T = 0.85
0.5	0.2	0.2
0.6	0.3	0.3
0.7	0.4	0.4
0.8	0.6	0.5
0.9	0.7	0.6
1.0	0.9	0.8
1.1	1.2	1.0
1.2	1.4	1.2
1.3	1.7	1.4
1.4	2.0	1.7
1.5	2.4	2.0
1.6	2.8	2.3
1.7	3.3	2.6
1.8	3.8	3.0
1.9	4.4	3.4
2.0	5.0	3.8
2.1	5.7	4.3
2.2	6.4	4.7
2.3	7.3	5.3
2.4	8.1	5.8
2.5	9.1	6.4
2.6	10	7.1
2.7	11	7.8
2.8	12	8.5
2.9	14	9.2
3.0	15	10
3.1	17	11
3.2	18	12
3.3	20	13
3.4	22	14
3.5	24	15
3.6	26	16
3.7	29	17
3.8	31	18
3.9	34	20
4.0	37	21
4.1	40	22
4.2	43	24

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RANGE (NM)	EFFECTIVE INTENSITY (cd)	
	T = 0.74	T = 0.85
4.3	46	26
4.4	50	27
4.5	54	29
4.6	58	31
4.7	62	33
4.8	67	34
4.9	72	37
5.0	77	39
5.1	83	41
5.2	89	43
5.3	95	46
5.4	102	48
5.5	109	51
5.6	116	53
5.7	124	56
5.8	132	59
5.9	141	62
6.0	150	65
6.1	160	69
6.2	171	72
6.3	181	76
6.4	193	80
6.5	205	83
6.6	218	87
6.7	232	91
6.8	246	96
6.9	261	100
7.0	277	105

Effective Intensity

The effective intensity of a flashing lantern comes from the following calculation known as Schmidt-Clausen or Blondel-Rey documented in IALA Recommendations E-122 (2001) and E-200-4 (2008). This method is valid for the rectangular, non-fluctuating flash profiles below the flicker fusion frequency (60 Hz) used by Carmanah lanterns.

$$I_e = \frac{I_p \times F}{C + F}$$

I_e = effective intensity (cd)
I_p = peak intensity (cd)
C = visual time constant (s)
F = flash duration (s)

The visual time constant is 0.2 s for a lantern at nighttime.

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Appendix G: Warranty and Customer Service Information

Warranty

This product is covered by the Carmanah warranty. Please contact Customer Service or an Authorized Carmanah Distributor for more information.

Customer Service

Before contacting Carmanah's Customer Service department, please have the serial number of you're M650 GPS available, a brief description of the problem, as well as all details of installation, storage, and recharging efforts.

To contact Carmanah's Customer Service Department:

Mail: Carmanah Technologies Corporation
Building 4, 203 Harbour Road
Victoria, BC Canada V9A 3S2

Phone: 1.250.380.0052
877.722.8877 (Toll Free in U.S. and Canada)

Fax: 1.250.380.0062

Email: customerservice@carmanah.com

Website: carmanah.com

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